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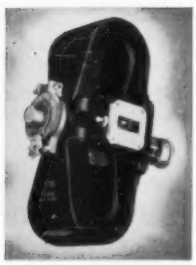
CANADIAN ELECTRONICS ENGINEERING



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One of the most up-to-date plants in the contemporary world of microwave has started tube production at Bomac's Route 128 site in Beverly, Mass.

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november 1957

volume one, number 7

CANADIAN ELECTRONICS ENGINEERING

Departments

***our cover design** *Fish are unresponsive creatures but even they may feel upset at the way television cameras are invading their privacy*

Heinemann's Series AM17 Circuit Breaker field assembled one-, two- or three-pole . . . interchangeable 400 ∿ or DC service

Developed especially for the rigorous demands of airborne service, the Series AM17 circuit breaker is now proudly flying with such dependable aircraft as Douglas' huge C-133.

The rugged AM17 operates on Heinemann's well-proven principle of magnetic actuation with hydraulic time delay. No de-rating, no compensation for ambient temperature or vibration necessary.

Easily "ganged" in the field for Companion-Trip® multi-pole applications, and designed for interchangeable service on 400-cycle and DC current, the AM17 may well be the *one* circuit breaker for all your equipment and circuit protection requirements.

Full details, including applicable military specifications, are furnished in Bulletin T-3302. Write for your copy.

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Circuit breakers

CANADIAN ELECTRONICS ENGINEERING

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contributors to this issue:

Has anyone a good used telescope or radio telescope? **Dennis Roddy,** author of "Tests prove narrow band mobiles can solve overcrowding" is interested in astronomy and is looking for a bargain.

Roddy has been in Canada since 1954. He was born in Scotland in 1931, did some schooling in Northern Ireland at the Belfast Technical College and then went back to England. In 1946 he left the Cambridge Technical College, a Grad E.E. of the British IRE and joined Pye working for them in Larne, Northern

Ireland and Cambridge. In Canada he is their Chief Telecommunications Engineer.

An athletic type—tennis and swimming —Roddy is also a hi-fi enthusiast and for relaxation plays chess.

Tomcio

Maine

Ever since he left the University of Toronto in 1954 **N. Tomcio** (Advantages of the slot antenna) has been working on transmission lines and microwave antennas.

Born in the Ukraine in 1918, the young Tomcio found his way to Germany, going to the university at Munich where, in 1949, he graduated in electrical engineering.

He took his MASc at the U of T when his thesis dealt with transmission lines. The research work was sponsored by DRB. He has had experience in television, servomechanisms, transistors and microwave work. He joined Canadian General Electric in 1954 and has been studying propagation and antenna design.

A. E. Maine (Nomograms ease design of cathode coupled amplifiers) has been in the guided missile field since early in the war. He had worked on automatic industrial control equipment with Marconi Instruments in England. In the army he lectured and did development work at the newly-formed R.A.E. Guided Projectiles Establishment.

After the war he joined the de Havilland Propeller Co. as an electronic project engineer and later became head of the electrical design group. Later he entered the company's guided missile division.

Since 1955 he has been a senior electronic development engineer with de Havilland Aircraft of Canada, guided missile division. As a member of a British government technical team he toured the U.S.A. in 1954 in the field of magnetic amplifiers — an area in which he has been active for some 10 years.

Honor of being the first author to appear twice in CEE goes to **W. M. Cameron** (Television helps engineers solve many underwater problems). His first article on NRC's Transponder Radiobeacon appeared in the June issue.

He joined NRC in the '40s and has been on varied projects. He has worked in the field with the UTV unit and has had considerable experience of its scope, and limitations.

Coming along, sometime in the not-too-distant future, should be an article on his present work — the development of a transistorized a-f amplifier.

a Maclean-Hunter publication

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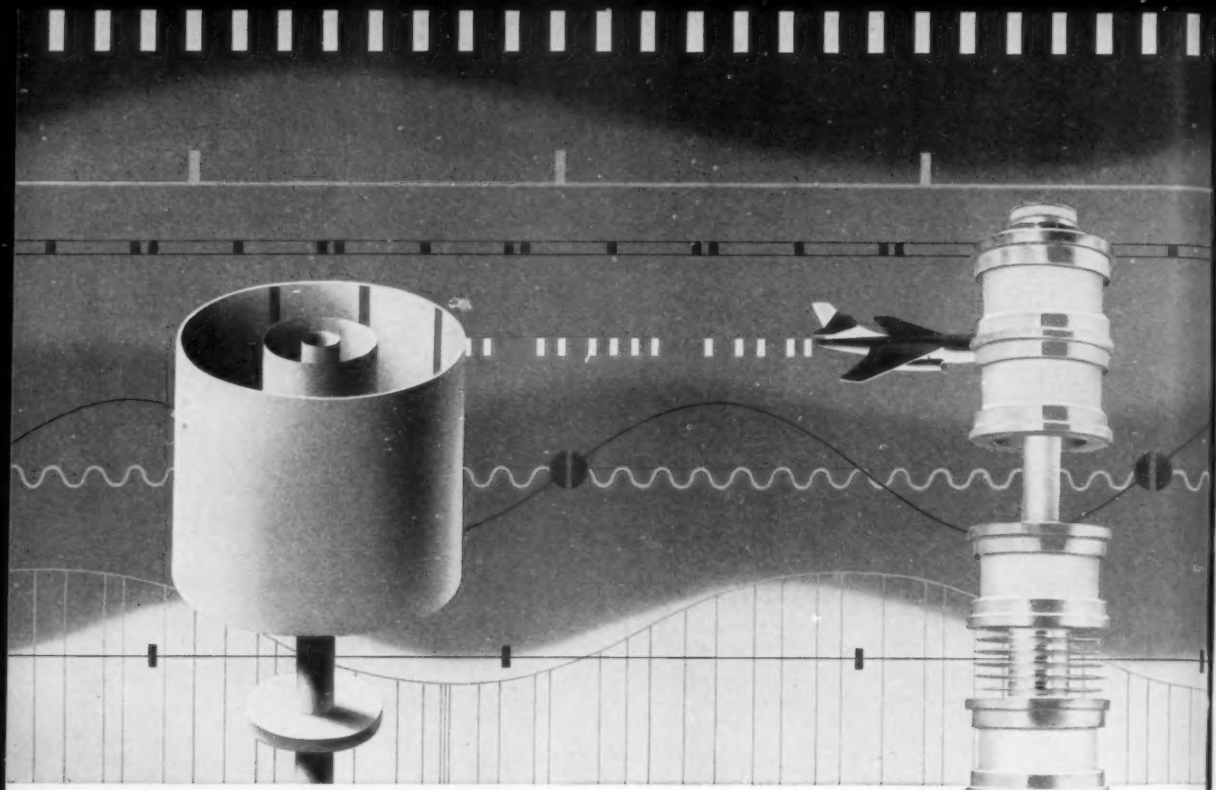

Eimac X676 Modulating Anode Klystron

Shaped RF Pulse, 30 KW Peak Power Output for 955-1220 mc Air Navigation Systems

Designed for air navigation systems, the Eimac X676 three cavity, air cooled klystron will deliver 30 KW peak power output in the 955 to 1220 mc range. With a power gain of 35 db, this tube has an efficiency of 40 per cent.

A typical air navigation systems requirement is a shaped RF pulse output to eliminate spectrum interference in adjacent channels. The Eimac X676 klystron is ideally suited to this service. The modulating anode permits pulsing the beam current while keeping the accelerating voltage constant. Also, the modulator circuit for this application is quite simple.

The RF cavities are external to the vacuum system and detachable from the klystron. The user may purchase spare tubes without buying additional tuning and focusing assemblies.

For the design engineer, the features of the X676 simplify circuitry—for the equipment operators the X676 provides reliable, long-lived performance at moderate cost.

For further information about the Eimac X676 Modulating Anode Klystron, consult our Application Engineering Department. Also available are two highly informative booklets; "The Care and Feeding of Klystrons" and "Klystron Facts . . . Case Four."

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Typical Pulse Operation X676

DC Beam Voltage	24 KV	Power Output	32 KW	Power Gain	35 db
DC Beam Current	3.3 Amps	Driving Power	10 watts	Average Power	1 KW
Power Input	80 KW	Efficiency	40%		

Appointments give CGE Board that Canadian look

Smith

All top-level managerial positions in Canadian General Electric are now occupied by Canadians. Most recent move has been the appointment of J. Herbert Smith as President and Chief Executive Officer. He is the first Canadian-born president of CGE since 1925.

Mr. Smith, 47, graduated from the University of New Brunswick, from which he holds the degree of Master of Science in electrical engineering, and joined Canadian General Electric. From Peterborough he went to Hamilton as a sales manager, in 1945 was made manager of supply sales in Toronto and in 1952 became general manager of the wholesale department.

Ian F. McRae, vice-president and general manager of the company's Civilian Atomic Power Department, has also been appointed to the Board. Mr. Smith and Mr. McRae replace Robert Paxton, executive vice-president of the General Electric Company and A. F. Vinson, vice-president, manufacturing of General Electric, who have resigned from the Board.

The Board of CGE now consists of 13 directors, nine of whom are Canadians.

Big turn-out for RETMA golf

Over a hundred golfers turned out for the annual RETMA-IRE golf tournament at Scarborough, near Toronto.

The IRE low gross trophy was won by G. Armitage of Canadian Radio Manufacturing Corporation Ltd. (Rogers Majestic Electronics) and the RETMA low gross trophy went to C. W. Peterson, Standard Coil Products Ltd. The Diamond State and Winners Prize for the tournament's low net score was won by P. Heenan of Centralab Ltd. and the Weston-Wrigley team trophy for the best 36-hole score by two players from one company went to J. Rees and W. Hodsoll of Canadian Admiral Corporation Ltd.

Director of White Radio Ltd.

W. H. Newport has been elected a director of White Radio Ltd., Hamilton, Ontario, manufacturers of Hammarlund products. Mr. Newport was also appointed vice-president and R. G. Stevenson secretary-treasurer of the company.

Mr. Newport who is sales manager and Mr. Stevenson, office manager, will also continue in their present posts. The company are sales representatives for the Belden Manufacturing Company.

Newport

Bier

Canadian Sales Manager for Chase Company

Bruce W. Bier has been appointed Canadian sales manager for Chase & Sons Inc., North Quincy, Mass., who manufacture electrical insulating tapes and materials.

A resident of Peterborough, Ontario, Mr. Bier has been associated with Canadian General Electric Company Ltd., for the past seven years.

Two appointments by Ontario Hydro

Robert H. Hillery has been made director of operations for the Ontario Hydro-Electric Power Commission. He succeeds C. B. Sharpe who has retired.

Mr. Hillery comes from England, receiving his education there and in Hamilton, Ontario. He joined Hydro's operating department in 1924, then went to the University of Toronto and graduated in 1931. He is a member of the A.P.E.O. and of the American I.E.E.

Another appointment by Ontario

Hillery

Zimmerman

Hydro makes Harold A. Smith assistant general manager, engineering. For the past few years Mr. Smith has been in charge of the Commission's nuclear development work carried out at Chalk River in conjunction with Atomic Energy of Canada Ltd.

New Company handles Clare products

A new company, C. P. Clare Canada Ltd., has been formed to manufacture and sell Clare electronic components. It is financed and entirely managed by Canadian industrialists, headed by G. Douglas Zimmerman, managing director of Fischer and Porter (Canada) Ltd. "Canadian financing and management of an American founded concern marks a realistic U. S. approach to the job of obtaining more business in Canadian markets" said Mr. Zimmerman.

Officers of the company, which will be at 2700 Jane Street, Toronto, Ont., are: president, Mr. Zimmerman; vice-president M. E. Pritchard, Chicago; secretary-treasurer Kenneth F. Waldron, Toronto; assistant-secretary, G. F. Crossman, Toronto. C. P. Clare of Chicago will be chairman of the Board. He was born in Rossland, British Columbia.

People and places

Carl A. Pollock, president of Dominion Electrohome Industries, Kitchener, Ontario, made the presentation of a $1,600 scholarship to 19-year-old Ronald Rothwell of Kitchener. The award is for the study of radio physics, electrical engineering, engineering physics or physics with electronics option at any Canadian university and is given to a graduate student of Kitchener-Waterloo or Eastwood Collegiate.

Charles P. Ginsburg, manager of Advanced Videotape Development, Ampex Corporation, has been presented with the David Sarnoff Gold Medal award for his achievements in the development of a practical video recorder.

Daly-Arrow Limited, 140 Kendal Avenue, Toronto 4, have appointed W. T. Barron, 939 Lakeshore Road, New Toronto, as their exclusive representative for the sale of electrolytic capacitors.

PYE at the IRE Canadian Convention

The success of any exhibition is judged by the number and interest of those attending it. Using this as our measure, our exhibit at the I.R.E. Canadian Convention was extremely successful.

Recognition and acceptance is as important to specialists in industry as to artists in their field. Confidence in our electronic engineering and precision built instruments was not misplaced.

If you were unable to call at our booth, and are concerned with the most up-to-the-minute developments in communications and instruments . . . please let us know.

Two-way Radio — Telephony — Industrial T.V. — Commercial T.V.
Instruments — Radio and Hi-Fi.

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New vhf communications link on St. Lawrence

Improved communications for shipping using the Gulf of St. Lawrence come from a new marine coast radio station at Fox River, Quebec, opened by the Department of Transport.

The station, on the easternmost tip of the Gaspe Peninsula, takes the place of the 53-year old station at Fame Point, 14 miles away. The Fox River station, which cost around $100,000 has vhf telecommunications system for ocean shipping, can transfer ship-to-shore telephone conversations to public long distance telephone circuits and is connected to department and public telegraph services.

The old Fame Point radio station was one of the first built in Canada in 1904. Because of its inaccessibility during winter it was only kept open during the navigational season.

Plant opened by closed TV circuit link

Carbide Chemicals Company's new plant in Montreal East was opened with the aid of a closed circuit television link recently. The circuit, installed by TelePrompter of Canada Ltd. between the plant and the Sheraton Mount Royal Hotel, a distance of 15 miles, gave a large screen picture to guests and an audio link with a commentator giving a description as the camera moved over the plant. The opening of a valve in the multi-million dollar polyethylene and petrochemicals plant ended the official ceremony performed by the Hon. Paul Dozios, Minister of Municipal Affairs, Province of Quebec. Cameras used were Pye image orthicon.

When the plant was being erected engineers used the IBM 650 digital computer to find the best way to run the ethylene oxide unit. The machine gave answers in two weeks to problems that would have taken a year by normal calculations. Carbide Chemicals is a division of Union Carbide Canada Ltd.

Atlantic cable boosts Corporation's profit

Telephone calls across the Atlantic are now running at over 1,600 a week, thanks to the trans-Atlantic cable opened a year ago. Before then calls were around 500 a week.

Increased business has helped Canadian Overseas Telecommunication Corporation to pull in a much improved net profit of over $400,000. Douglas F. Bowie, president and general manager of the Corporation says that the capacity available for Canadian purposes on the cable was immediately taken up and that a second cable between Canada and the U. K. is planned to meet anticipated growth. The cable is expected to be ready for operation during 1961.

More light for Niagara

A British Company, Amalgamated Electric Corporation Ltd., an associate company of the General Electric Co. Ltd., of England, has been awarded a $154,000 contract for the provision of a new floodlighting system for Niagara Falls.

The contract, which is being handled through Northern Electric Co., Ltd., involves 20 specially designed weather-proofed high-intensity carbon-arc projectors incorporating remotely controlled automatic color changing devices. The units, operating on 150 amps at 75 volts will consume the same amount of power as the 24 floodlights they replace but give ten times the brightness.

Company takes over Montreal plant

Radium Dial Corporation, 920 McEachran Avenue, Montreal, have purchased the Montreal plant of Radelin-Kirk Ltd., formerly a wholly owned Canadian subsidiary of United States Radium Corporation.

Big maintenance contract for R.C.A. Victor

Among contracts awarded during the first half of September by the Department of Defence Production was one to R.C.A. Victor Co. Ltd., Ottawa, Ontario totalling $261,147 for the maintenance of microwave and associated electronic equipment. The same company have a contract, value $22,336, for radar modification kits.

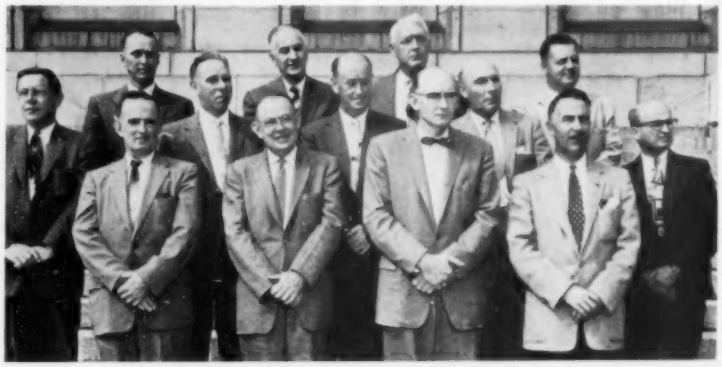
Other recent major defense contracts: Northern Electric Co. Ltd., Ottawa, Ontario, spares for teletype equipment, $146,037; Mechron Engineering Products Ltd., Ottawa, Ont., aircraft instrument test equipment, $31,938; Canadian General Electric Co. Ltd., Toronto, Ont., electronic tubes, $14,210; Alpha Aracon Radio Co. Ltd., Toronto, Ont., resistors, $13,884; Decca Radar (Canada) Ltd., Toronto, Ont., radar equipment, $12,-485; Beaconing Optical and Precision Materials Co. Ltd., Montreal, Que., spares for communication equipment, $10,785.

News in brief

Canada Wire and Cable Company Ltd., Toronto, have made the following appointments: Frank Ashworth, general manager; J. F. Maskell, controller; J. H. Stevens, manager of general plant planning; R. L. Hart, manager of industrial relations.

Lee Bern and Company Ltd., an electronics and electrical wholesaling business, has moved its location to 341 William Street, Winnipeg.

Electronic Service Supply Co., Ltd., are opening an office in Toronto to provide coast-to-coast coverage for their products. The company's main office is in Calgary, Alberta, with branches at Edmonton, Alberta, and Regina, Saskatchewan.



Transport Department's Radio Regulations Inspectors from across Canada met in Ottawa on Civil Defense matters. Left to right: (front) A. P. Stark, Chief Radio examiner, Ottawa; W. A. Caton, head, inspection and examinations section, Ottawa; Frank Grant, Regina, Sask.; C. M. Brant, comptroller, Radio regulations, Ottawa; (second) Ted Ginn, Saint John, N.B.; Tom Slinn, Toronto; Maurice Martin, Vancouver; Charlie Williams, Moncton, N.B.; B. Monday, Montreal; (back) Eric Shea, Winnipeg; R. C. Peddle, St. John's Nfld.; H. Lane, Halifax; R. Goldsalve, Edmonton.

Monitor radiated signal frequencies 100 times faster!

with accuracy of ± 1 cps...over range of 0.54-30.5 megacycles

Beckman/Berkeley Model 7700 Microsensitive Frequency Measuring System

Featuring

Exclusive direct digital readout – 7-place numerical display for speed, accuracy and convenience.

Broad utility – measures AM, ICW, frequency shift keyed and multiplexed signals.

Extreme sensitivity – detects and measures signals of 1 microvolt strength.

Advanced engineering design – exceeds FCC specifications, is suitable for compliance with Part 15, FCC Rules and Regulations.

Wide range and bandwidth selectivity – 30 1-mc frequency bands; bandwidth of 100 cps-6 kc for interference rejection.

Price: $3500.00 F. O. B. factory

DESIGN AND PERFORMANCE SUPERIORITY

Comprising a unique combination of a quality communications receiver and a high-speed electronic counter, Beckman/Berkeley Model 7700 provides 100,000 times the customary counter sensitivity, and 100 times the frequency measurement speed of other equipment. Its extreme sensitivity and accuracy permit quick, precise measurement of virtually all types of radiated signals in the 0.54 to 30.5 megacycle range, with maximum error of 1 in 10^7.

Simple and easy to use, the Model 7700 makes possible the measurement and monitoring of broadcast or other frequencies by non-technical personnel with a minimum of training. The system consists of three basic units: a broad range communications receiver, a translator with oscilloscope comparator, and a time-gated electronic counter. An audio system is incorporated for aural monitoring where desired.

Complete technical information on the Beckman/Berkeley Model 7700 Microsensitive Frequency Measuring System is available on request. Write to Dept. M11.

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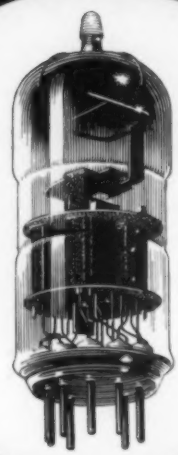
The 6922/E88CC Double Triode is one of a line of Rogers Special Quality* ruggedized tubes. Its gold plated frame grid construction assures high transconductance, close tolerances and consistant performance. The tube also has gold plated pins to minimize contact resistance and corrosion. Under fair conditions of use, its life should exceed 10,000 hours.

Produced under exacting design and production measures, this Rogers Double Triode is especially suitable for reliable cascode amplification, high speed computor applications, and low noise, high gain RF Amplifiers.

**Rogers Special Quality tubes are finding more and more applications in all types of professional equipment. The greater reliability and lower maintenance cost of the apparatus in which they are used more than compensates for the higher initial cost.*



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DC to 10 MC. Plug-in preamplifiers
24 direct reading sweep times
Sweeps 0.02 μsec/cm to 15 sec/cm
"Universal" automatic triggering
New, ultra-conservative design

New Model 150A is not a "warmed-over" imitation of previous oscilloscopes. Instead it is a totally new kind of instrument whose radical design approach obsoletes old standards of oscilloscope versatility, simplicity and dependability.

Specifications given here spell out the 150A's unique usefulness. Its simplicity and reliability stem from such unique features as: ***Unitized circuits,*** easily isolated for testing or service, etched and mounted on translucent plastic. ***Highest quality components,*** operated well below ratings. ***Concentric, color-coded,*** functionally-grouped controls. ***Direct sweep-time selection;*** no mental gymnastics. ***Universal automatic triggering*** system wherein one preset adjustment provides optimum triggering for almost all conditions.

Wouldn't you prefer a ***really new, convenient*** oscilloscope? Call your *-hp-* representative today for the complete story. Or, write direct.

SPECIFICATIONS

Sweep Range: 0.02 μsec/cm to 15 sec/cm.

Calibration: 24 sweeps: 1-2-5-10 sequence, 0.1 μsec/cm to 5 sec/cm; 3% accuracy.

Triggering: Internal, line voltage or external 0.5 v or more. Pos. or neg. slope, +30 to −30 v trigger range.

Preset Trigger: Optimum setting for automatic stable triggering.

Horizontal Amplifier: Sweep magnification 5, 10, 50, 100 times. Vernier position control selects any 10 cm part of sweep. External input pass band dc to over 500 KC. Sensitivity 200 mv/cm to 15 v/cm.

Vertical Amplifier: Pass band dc to 10 MC. Optimum transient response and rise time less than 0.035 μsec. Signal delay of 0.25 μsec permits leading edge of triggering signal to be viewed.

Amplitude Calibration: 18 calib. voltages, 1-2-5-10 sequence, 0.2 mv to 100 v peak-to-peak. Accuracy 3%. Approx. 1 KC square wave, rise and decay approx. 1.0 μsec.

Prices: -hp- 150A High Frequency Oscilloscope, $1,100.00
-hp- 151A High Gain Amplifier, $200.00
-hp- 152A Dual Channel Amplifier, $250.00

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505 McIntyre Bldg., Winnipeg, Manitoba
Data subject to change without notice. Prices f.o.b. factory.

also offers -hp- 130A Low Frequency Oscilloscope, dc to 300 KC, sweeps 1 μsec/cm to 12.5 sec/cm.

Scientific revolution

The defence spending program has "forced" a scientific revolution in America and initiated a new era of economic and cultural growth, says Frank Pace, Jr., president of General Dynamics Corporation.

"The tremendous scientific and technological advances brought to fruition by our defence spending — nuclear fission and fusion, astronautics, new aerodynamic and hydronamic forms, electronic computation, communication and automation — have already spilled into industrial, commercial and consumer fields," he declared.

Because the penalty for lagging or faltering in the arms race is quite conceivably annihilation, he added, programs of research are based on a philosophy of "reaching for the ultimate," a process that has condensed the progress of 50 years into 10.

Future mail by missile?

The technology that has conceived and is producing guided missiles as weapons of war will lead to great advances in methods, equipment and materials for use in every phase of future peacetime life, says Howard L. Richardson, Sylvania vice-president, electronic operations.

Missile electronics technology, he said, is a field with a vast potential. Such technology would be of great advantage in research of the upper atmosphere in such areas as radio and micro-wave communications, radar and "space travel."

"A very distinct possibility for the future is the long distance delivery of mail and freight by missile. Scientists have also given some thought to intercontinental and other long-distance world travel by missile."

Television aid to welding

A new boom for welding the internal longitudinal seams in small-diameter pipes, incorporates television equipment for guiding the welding head. It is made by Quasi-Arc Ltd., Bilston, Staffordshire, England.

The equipment can be used for pipes up to 28 ft. in length and consists of a tubular steel boom, fitted to a fabricated steel support structure. The television camera is close to the welding nozzle pointed in relation to the seam.

INDUSTRY REVIEW & FORECAST ISSUE of

CANADIAN ELECTRONICS ENGINEERING

January 1958

In January, 1958, Canadian Electronics Engineering will publish its first Annual REVIEW & FORECAST of Canada's electronics industry. Well-illustrated by photos, charts and tables—this will be the most comprehensive report on the industry ever made to Canadians engaged in electronics and its allied fields.

The Annual REVIEW & FORECAST will feature new equipment, contracts received and contracts completed, and report on all significant increases in volume and areas of activity.

Packed with authoritative information on past, present and future electronic developments, this January issue of Canadian Electronics Engineering will be awaited with more than usual interest by all our readers . . . the people in Canadian industry who buy and specify electronic equipment.

The importance of the Annual REVIEW & FORECAST and the assured interest in it makes the January issue of Canadian Electronics Engineering one of the year's best advertising buys.

If you manufacture or supply electronic equipment, the ANNUAL REVIEW & FORECAST presents you with an excellent opportunity to tell Canadian buyers about your products.

Reserve extra space to tell your full story now!

Closing date is Dec. 18, 1957.

CANADIAN ELECTRONICS ENGINEERING

THE MACLEAN-HUNTER PUBLICATION

481 University Avenue Toronto

Two thirds under

WITH water covering most of the earth, man intrudes more and more into this element. And guiding the way, PYE Underwater Television enables the engineer to control underwater inspection from the surface, in complete comfort.

Many large companies, such as Shawinigan Engineering, Foundation of Canada Engineering Corp. Ltd., British American Oil Company, Canadian Broadcasting Corporation, National Broadcasting Company, U.S.A., and the Royal Canadian Navy have successfully used Pye underwater equipment. For example, Winnipeg Hydro Electric recently inspected 16 underwater penstocks with Pye Underwater Television at an estimated saving of $35,000.

TELEVISION DIVISION

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Whenever you wish to inspect anything underwater — dams, piers, penstocks, foundations, ships bottoms or sunken objects, ask a Pye representative to show you how it can be done better, at less cost.

He doesn't worry about remote, unattended stations

. . . he's leaning against *Lenkurt* 51B Supervisory and Control equipment

Long distances between headquarters and remote, unmanned stations are no longer a cause for concern.

Now up to 80 supervising and alarm functions and 90 control and operating functions can be handled over one voice circuit with Lenkurt's 51B Supervision and Control System.

HOW IT WORKS

When a condition changes at a remote point, a relay is activated. This automatically "dials" a reporting lamp (and alarm bell) at the control centre and then disconnects—leaving the circuit free for other signals.

The operator at control then dials a 2-digit number to correct conditions at the remote station. The circuit is again released after the corrective function has been started.

Every time a change condition is reported a scanning operation automatically checks all other supervised functions. This check may also be initiated at the control.

The equipment is available in standard pre-engineered package units. It works over wire cable and radio. Familiar telephone type relays are used, for easy servicing. If your operation involves remote stations, investigate the efficiency and the savings offered by Lenkurt Type 51B Systems.

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AUTOMATIC ELECTRIC

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5746—C

More basic research vital to the industry

Let's take a look at reality—as the electronics industry saw it at the Canadian IRE show in Toronto last month. Slowing down of the vast rate of expansion that happened between 1948 and 1955 has not necessarily been a bad thing; but the general feeling at the Show was that the financial "plateau" could continue until late next year.

One executive put it this way: "With guided missiles making the fighter plane outdated the Canadian government doesn't know what to do about defense work. There is a limit to what we can afford for defense in this country—at the moment it looks as if the electronics industry is going to suffer because the Government can't make up its mind."

At the same time, it was obvious from the Show that the industry is not sitting back. There were signs of considerable Canadian (as distinct from American-inspired) development in the communications and computer application fields. Faced with the challenge of a changing market the industry is coming up with some bright ideas.

One of the minor signs of the "squeeze" was that some companies restricted the number of engineers visiting the Show, purely, it was said, for reasons of economy. On the other side one exhibitor was so enthusiastic about the sales and enquiries he had received that he wanted to double his space in next year's exposition.

From many comments made, one general fact does arise: there ought to be more government money available for Canadian research in the electronics fields. We cannot afford to lean too heavily on the Americans—and in any case it should not be merely a question of dollars and cents. The financial burden of research is too great for individual companies. But with support from a government that understood the problems involved (and did not expect immediate returns for its investment) there could be great benefits to Canada.

There were people at the IRE Canadian Show who talked like the Prophets of Doom. They represented only a fraction of the total and had obviously grown lazy in the days of big defense contracts and boom conditions. The general approach was that the next year would represent a big challenge which would bring out the best in Canadian electronics. As an industrialist said: "We can keep up our $500 million turnover a year without any problem—and no industry with that potential can say the future looks black. What we've got to do is be prepared to spend more and more on research, and pay premiums for initiative. Then the industry must expand again."

Which seems a good enough summing up. While there is no room for complacency, restrained optimism is quite in order.

THE EDITOR

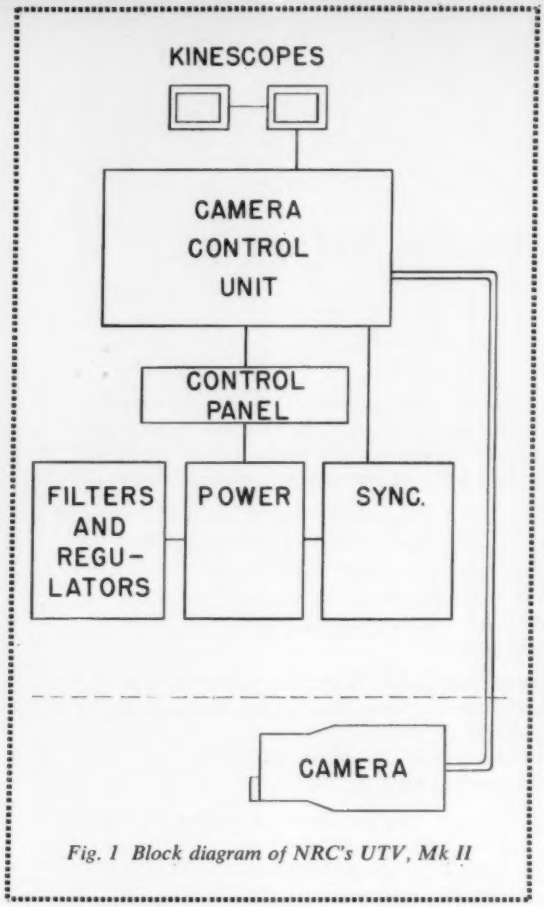


Fig. 1 Block diagram of NRC's UTV, Mk II

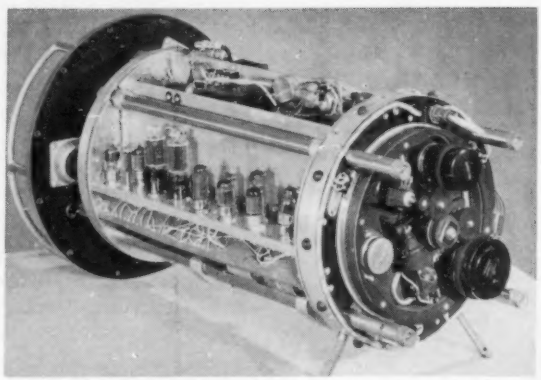


Fig. 2 Camera withdrawn from its case. Rear of the case is permanently attached by shock mounts. Rubber bumpers around the front plate cushion shocks to the lens end

Television helps engineers solve many underwater problems

W. M. CAMERON*

During the last ten years considerable work has been done with underwater television in both salvage and inspection operations. It is proving an invaluable aid to the diver, particularly at depths greater than 350 feet where great pressure reduces his efficiency. This paper deals with a system developed by the NRC and describes some of the problems encountered in underwater research

*National Research Council, Ottawa

Underwater television was used as early as 1946 to examine ships sunk by an atomic blast at Bikini, and later found its way into the news in locating the lost submarine "Affray." The National Research Council developed an experimental system, the U.T.V. Mk. I in 1950 to study operational problems. This was replaced in 1955 with an improved development, the U.T.V. Mk. II, a block diagram of which is shown in fig. 1.

An extensive survey of fish life in Lake Minnewanka, examination of submerged concrete structures at a hydro-electric generating plant, viewing the condition of a submarine power cable, a study of scallop-drag efficiency and an underwater survey of a 2,000-foot sea wall are typical projects undertaken with the two systems. Experience

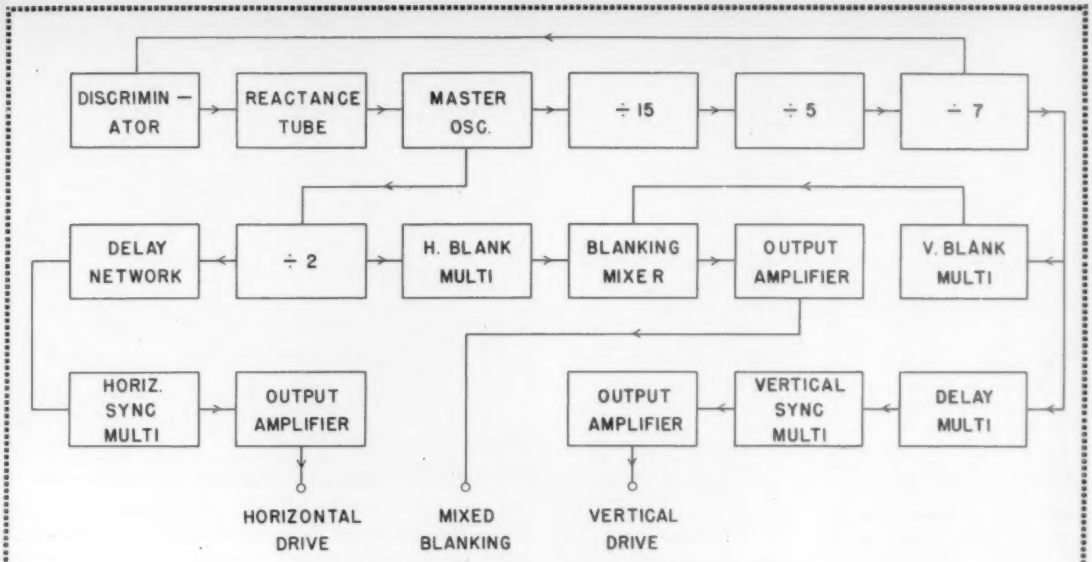


Fig. 3 Block diagram of the synchronizer

with the earlier equipment was most valuable in the design of U.T.V. Mk. II, in that it enabled us to retain valuable features of the older equipment and add others found to be desirable.

The Mk. II Equipment — Camera

The sweep and image-orthicon circuits are quite conventional[1]. The pre-amplifier has a 3 db upper frequency limit of 8 megacycles per second and includes the usual phase and amplitude equalization. The camera has a three-lens turret with selection of lenses, focusing and control of iris diaphragms done remotely from the operating position at the surface. An inclinometer and water leak detector are included. The camera, shown in fig 2, is enclosed in an aluminum alloy case about 14 inches in diameter and 26 inches long and weighs, complete, about 150 pounds in air and is near neutral buoyancy in water. The case has eight bosses to which a variety of handling gear may be attached, as required by the individual field operation. Maximum operating depth is 500 feet.

The Synchronizer

The standard 525 line interlaced scan is used, as we have at times been called upon to work into commercial television stations. Interlace is achieved by choosing a suitable ratio between the horizontal and vertical scanning frequencies. The vertical scanning frequency is also locked to the power line frequency to ease the problem of providing sufficient filtering in H.T. power supplies. As shown in fig. 3, a master oscillator at 31,500 cycles is used and the horizontal scan frequency derived from it by a two-to-one frequency divider. The vertical trigger is taken from a 525:1 divider from the master oscillator. The vertical scan frequency is compared to the power line frequency in a discriminator, the output of which controls the frequency of the master oscillator. Thus the ratio of horizontal to vertical scan frequencies remains 525:2 if the power line frequency should vary. Permissible departure of power line frequency from the design centre is about ± 1 cycle per second for simple frequency dividers using multivibrators or blocking oscillators and this restriction on line frequency variation was considered too tight for field use so groups of binary scales were used. As the 525:1 division cannot be easily done directly, it is accomplished by a cascade of dividers. The use of binary scalers allows one to use three dividers: 15 x 5 x 7.

The Frequency Dividers

The binary scalers used in the synchronizer, shown in fig. 4 are Eccles-Jordan bi-stable multivibrators with negative trigger common to both plates. Small neon indicator tubes enable the operator to spot a faulty scaler. As a differentiated negative-going waveform is taken as a count, the application of two input trigger pulses is necessary to obtain an output count. The count of one scaler is used as a trigger for the second one of a chain and the total count for the chain is 2^n where n is the

Underwater television picture of a Rideau Canal lock showing part of the sluice gate. It was taken with a clearwater container, visual range 8 inches, 35 mm lens

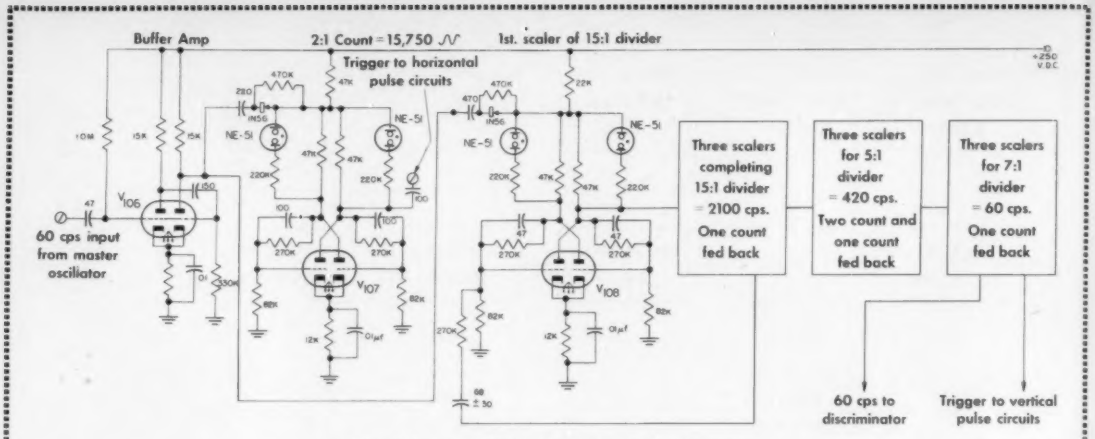


Fig. 4 Frequency divider schematic diagram

number of scalers. Thus a string of four scalers would give one output pulse for each 16 input pulses.

As it is desired to have a count down ratio of 15:1 for the first divider chain in the synchronizer, one count is fed back over the chain to the input scaler V 108. This pulse is counted, therefore only 15 additional pulses are required to secure an output count and the 15:1 count is achieved.

Three scalers are used in the 5:1 divider but here it is necessary to feed back three counts. A pulse from the output scaler is fed back to the input of the chain and counts as one. The same pulse is fed into the second scaler where it appears as a 2-count. The 7:1 divider also uses three scalers with one count fed back.

The output of the final tube on the 7:1 divider is used as a trigger for the vertical blanking and drive pulses at a nominal frequency of 60 cycles per second. Square wave output from the other plate of this tube is taken to a discriminator which works into a reactance tube connected to the master oscillator to hold it at 525 times power line frequency. A phasing circuit in the reference input to the discriminator is initially adjusted for best picture shading. The reactance tube will swing the master oscillator frequency over a range of about 4,000 cycles per second which corresponds to a power line frequency deviation of 8 cycles per second, so tuning condensers are switched across the oscillator coil to secure lock-in ranges of 52 to 58 cycles, 56 to 64 cycles and 62 to 70 cycles.

Although the master oscillator frequency swings from 26,000 to 36,700 cycles over the three bands, the operation of the dividers is faultless, as frequency division is not dependent on time constants — rather each cycle of the master oscillator is counted. This feature has been found invaluable on more than one field project. Trigger for horizontal blanking and driving circuits is taken from a binary scaler which counts down 2:1 from the master oscillator frequency.

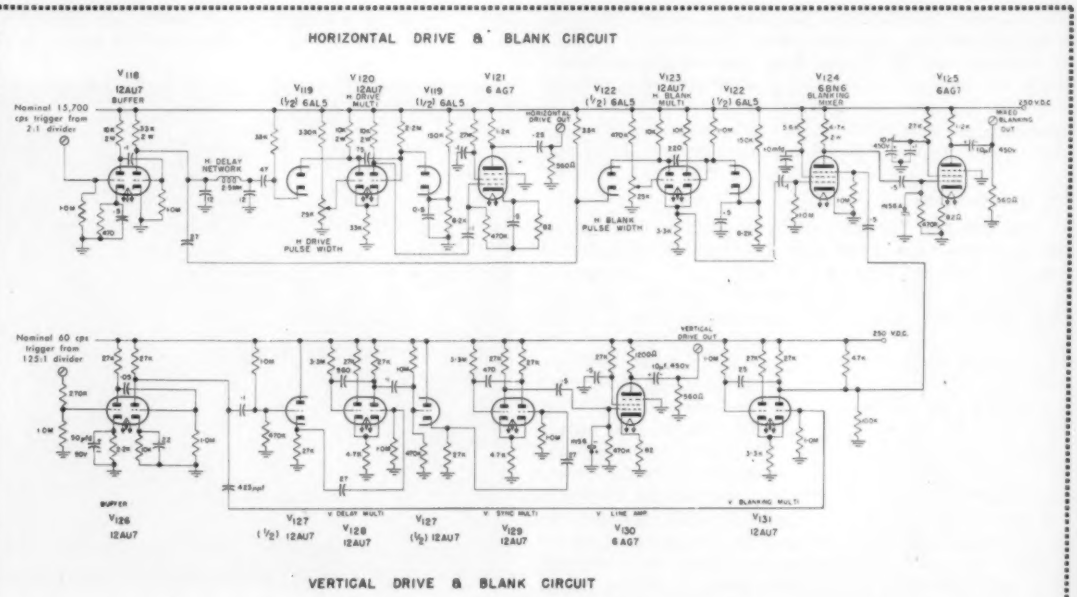


Fig. 5 Schematic diagram of the pulse generator section

Fig. 6. The control console breaks down into five units. These can be shipped, easily assembled in confined spaces

The Pulse Generator

The circuit diagram for the pulse generator section is shown in fig. 5. A buffer amplifier, V126, is used to prevent undesired leakage into the 525:1 counter chain. This tube feeds a monostable multivibrator, V131 to generate vertical blanking pulses which are fed to the blanking mixer, V124. V126 also works through a cathode follower into a monostable multivibrator, V128. This circuit is used to provide a delayed trigger into V129 which generates the vertical drive pulse so that the drive, or sync, pulse will fall within the blanking interval. V130 is a line, or output amplifier.

The output of the 2:1 counter is fed into the buffer amplifier V118. The output of the tube is used to drive V123, which generates horizontal blanking. Catch diodes, V122, are used to increase the rapidity of conduction transfer in this multivibrator as the horizontal blanking pulses have length of only a few microseconds. These pulses are mixed with the vertical blanking pulses in V124 and amplified by the line amplifier, V125.

V118 also drives V120, the horizontal drive multivibrator, through a simple pi-section delay network. V119 is the catch diodes and V121 is the line amplifier. The synchronizer outputs are taken to the camera control unit where the mixed blanking is superimposed on the video signal, while the horizontal and vertical drive pulses are distributed to drive camera and monitor sweeps as well as to synchronize viewing and photographic monitors.

The Camera Control Amplifier

Particular attention was paid to clamping black level reference in the design of this amplifier, as the system is always operated at high video gain. Two driven clamps[1] were used in the camera control amplifier strip and make for good black level reference. Mixed blanking is inserted prior to the first clamp, but all synchronizing and driving pulses are carried by cables, which makes the use of a "supersync" waveform unnecessary. The usual linear shading controls are included but more complex shading waveforms were discarded in the interests of simplicity of operation. Performance is quite satisfactory at maximum video gain on the low-contrast pictures peculiar to underwater television.

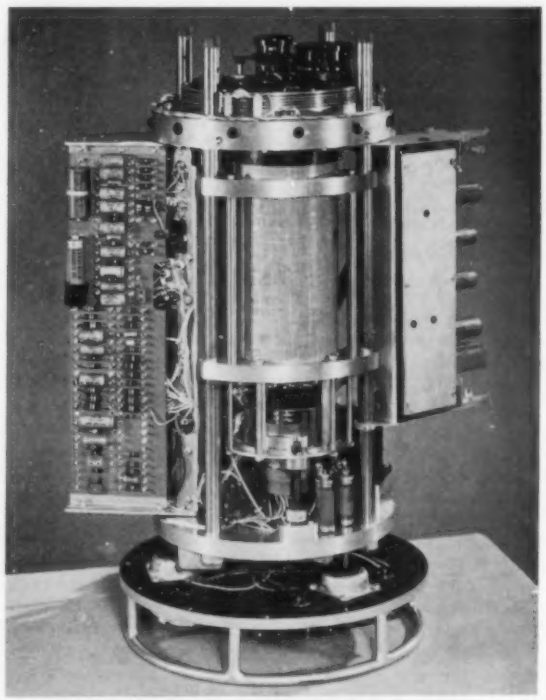
The Operating Console

The camera control amplifier, along with the image orthicon control panel, video oscilloscope and monitor kinescope comprise the camera control unit, at the upper end of the console. The centre unit of the base, shown in fig. 6, contains the transformers and selenium rectifiers and is sandwiched between the synchronizer and the regulator-filter units. A small control panel buttons on these units just below the camera control. All units which may require tube replacement or repair in the field are readily accessible. An eight-inch fan is used for cooling, the air stream being directed by baffles, while some chassis are used as air ducts. Although the input power is about 1,500 watts, the case temperature is never more than about 5 degrees above ambient in prolonged operation. As the only openings are the intake and discharge ports, water dripping from leaky decks found on some ships is more a source of operator annoyance, than an equipment hazard.

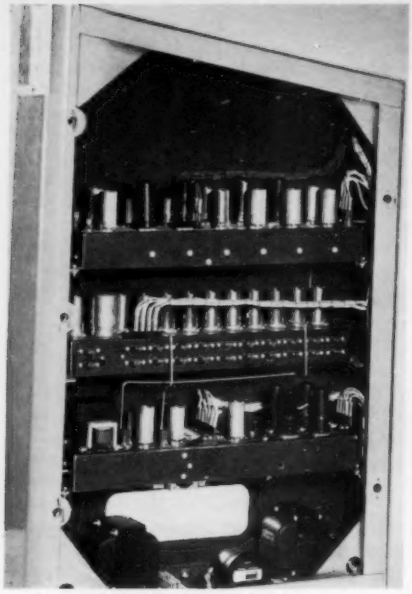
Water Turbidity

As an underwater television camera is submerged in typical river or coastal water, the picture contrast degrades into two shades of grey, or in some cases it may be lost entirely against a grey background. This startling loss of definition is caused by small solid particles in the water which scatter light as do water droplets in atmospheric fog, with equally deleterious results. In the video circuits, signal due to light scatter appears as a d-c component, and may be rejected by adjustment of the blanking clipper. Video gain is then increased in an attempt to recover contrast, but the maximum gain is limited by the appearance of system noise and random picture shading.

Visual ranges through waters in which much of our work has been done are from six inches, found at Port Weller, Ontario, to eight feet, found near Grand Manan Island off the New Brunswick coast. Turbid water will nearly always be encountered where underwater repair or salvage is under way but a visual range of 15 to 20 feet is possible in very clear water. Chesterman and Collins[2] have shown that no optical artifice will eliminate or sensibly reduce fog due to water turbidity. Other



Sweep chassis and preamp swing out on camera



Synchronizer assembly

Welland canal area, visual range about 18 inches

than increase video gain, the best that can be done is to arrange lighting so that the water between camera and subject is not illuminated; 45-degree lighting is recommended. We have found a clear-water container, as used by Bathurst[3] and others, to be invaluable for work in very turbid water if little depth of field can be tolerated.

Water turbidity should be known before committing underwater television to a project. As estimates of transparency made at the surface are very misleading, measurement of attenuation should be made with a hydrophotometer[2],[4], or, if such instrument is unavailable, a Secchi disc[5],[6]. While notation and system of units vary with the author, some form of the absorption equation $I=Io\epsilon^{-K1}$ is used to express attenuation. Williams[4] uses the convenient logarithmic form $\alpha = \frac{1}{L} \log_{\epsilon} \frac{100}{T}$ where $\frac{1}{L}$ —is the path length, L is the oceanographic standard of 1 meter, and T is the percentage of light transmitted. The attenuation coefficient, α, may easily be related to other methods of expression. The relation between Secchi depth with fraction of light lost per foot of water, as given by Cross[6], is inexact. A modification of the limiting range equation given by Chesterman and Collins should be more satisfactory.

Because of the restricted visual range, a bottom search with the camera towed by a ship is a difficult and expensive operation. The ship is subject to wind and tide making her position relative to the bottom quite indeterminate and the camera position even more so. Other devices such as Asdic or magnetometer should be used to establish contact over which a buoy is dropped. Underwater television may then be used to identify the object.

Camera handling is worked out in advance of each project and modified on location as necessary. The camera may be trained on the subject by a diver, or where divers cannot be used, it may be oriented by a weighted guide line and steering ropes. In one project it was necessary to mount the camera on a submarine sled[7]. Camera cases fitted with steering and propelling motors are ideal for work in still water but are useless in current and because of their bulk and weight are not practical for many operations. Streamlined, finned cases tend to look upstream in currents when a cross view is wanted in most projects.

Photographic records may be made from the kinescope picture, using an exposure of f/5.6 at 1/25 second with film having an ASA daylight rating of 200. Slower shutter speeds are permissible but none higher than 1/30 second should be attempted as this time is required to complete one television picture frame. Motion picture cameras with synchronous motor drives and special shutters are commercially available and should be used when cine records are desired, otherwise vertical blanking shows in the projected picture as dark bars moving vertically. Photography can be done in normal daylight if a lens hood is used on the camera.

Engineers and scientists associated with field projects involving the use of underwater television thought that the direct view thus secured contained much more information than a diver's description and permitted group studies. Photographic records were also considered to be vastly superior to diver's notes. They agreed, however, that the system had limited use in very turbid waters.—END

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N. TOMCIO, P.ENG.*

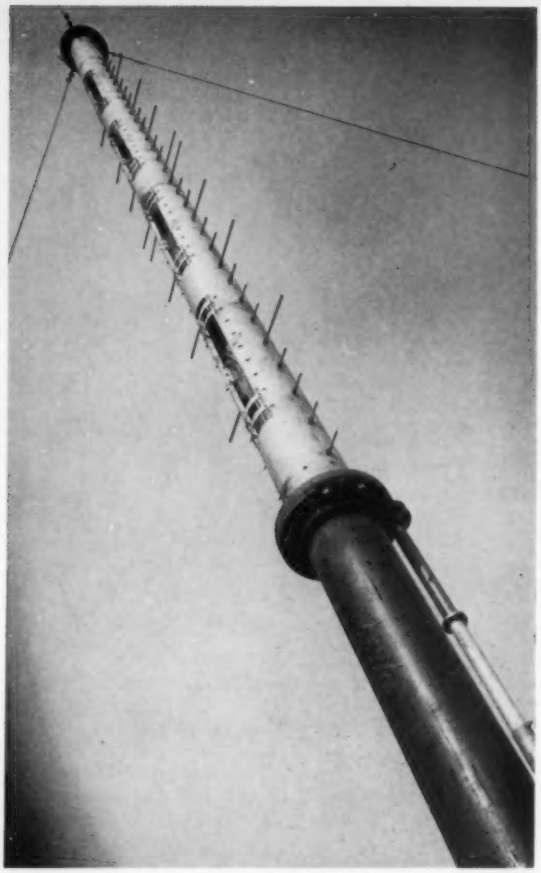


Fig. 1. A four-slot section of a TV transmitting antenna

The increasing use of slot antennas in modern aircraft has been fairly well publicized in recent years but the advantages of the slot principle to television broadcast station operation may not be so well known. Although they are not intended to replace the turnstile antenna, some technical and cost advantage will be achieved by the station which can make use of a slotted cylinder antenna

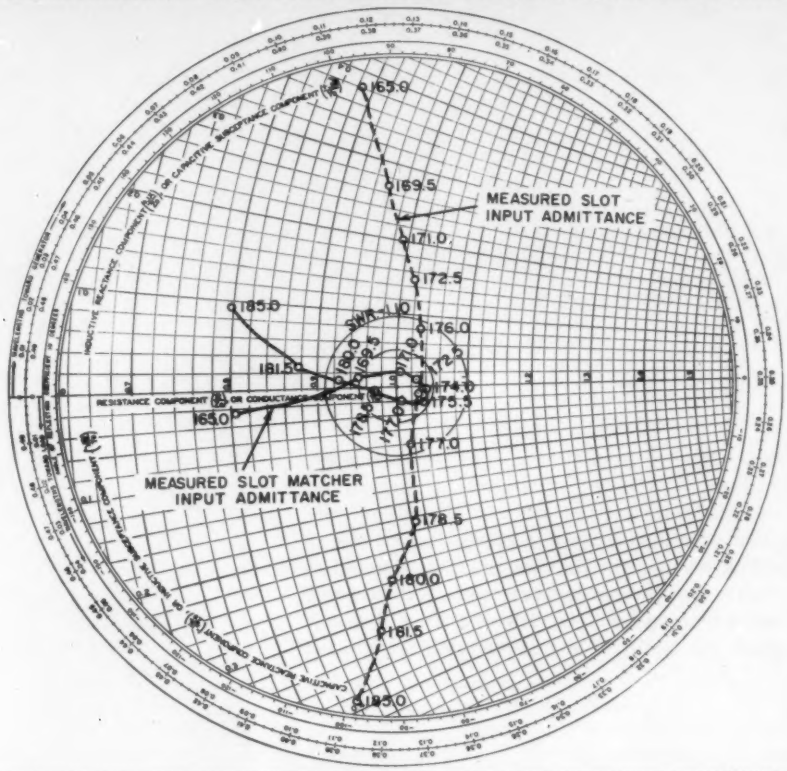
Advantages of the slot antenna for television stations

At the present time, the turnstile type antenna provides the best omni-directional radiation pattern for television broadcasting. However, the slot antenna, with some modification of this circular pattern, provides a lower cost antenna that will give a higher maximum gain using fewer parts in a very reliable structure. In addition, it can be designed to produce many variations in the radiation pattern for specific coverage requirements. With these factors in mind the Ultra-Power antenna was designed during 1955 at Canadian General Electric Co. Ltd., and recent installations are giving satisfactory service.

The slot antenna, in general, employs an aperture in a conducting surface either plane or curved. For some applications where air friction, free air flow, or wind load are important factors, the slot in a conducting surface offers a great advantage over the projecting type of radiators. For a stationary application such as a TV transmitting antenna, a slotted cylinder array offers a considerable reduction in wind load and a saving in the supporting structure as compared with the conventional turnstile antenna.

The general radiation characteristics of a slot can be deduced from the electromagnetic duality theorem which is known as Babinets principle. From this it can be shown that a vertical slot radiates a horizontally polarized field, whereas a horizontal dipole will radiate a horizontal field. The slotted cylinder can be developed from the slot in a conducting sheet by enclosing the slot on one side of the sheet with a cavity, and then, by folding the sheet around the cavity, a slotted cylinder is formed. The cavity will load the slot inductively, increasing the velocity of propagation along the slot, thus increasing the slot wavelength above the free space wavelength. This property can be used by the designer as a means of obtaining additional power gain in a slot antenna. This effect

*Canadian General Electric Co. Ltd., Toronto



This Smith-chart illustrates the method of reducing the slot vswr by the use of a slot matcher

Y_0=12.9 micromhos

depends on the diameter of the cavity and becomes significant if the diameter is reduced below a quarter wavelength.

Another factor of importance in the design is the radiation pattern and its effect on the power gain. The shape of the horizontal radiation pattern depends on the outside diameter of the cylinder. It is close to circular for diameters smaller than 0.1 wavelength. With increasing diameter the pattern becomes more directive and approaches the shape of a cardioid when the diameter reaches on wavelength. In a television broadcast system only the energy radiated within a few degrees of the horizontal direction can be received. Energy radiated above or below this point is wasted. An economical use of transmitter power calls for an antenna system which concentrates the radiated power in a narrow beam in the horizontal direction. This can be accomplished by stacking a number of single radiators or slots into a collinear array. A uniform array consisting of a number of slots, spaced equally, and fet in phase by equal power, offers the simplest design. The use of a full-wave slot provides a considerable increase in gain per feed line, as compared with a half-wave radiator. This will amount to an RMS power gain of one and one-half per slot. The RMS power gain is the gain achieved by directivity in the vertical plane, if it were radiating equally in all horizontal directions.

As previously explained, the shape of the horizontal pattern is affected by the diameter of the cylinder. For this reason the pattern is not omni-directional, and tends to radiate most of the power in one direction, which will be the side of the cylinder where the slot is located. For a cylinder diameter of one quarter wavelength, horizontal directivity accounts for a further power gain of about two per slot. Taking into account the directivity in both the vertical and horizontal planes, there will be a power gain of three per slot, as in the Ultra-Power design, in the direction of maximum radiation. A four-slot collinear array will thus have a maximum power gain of twelve.

Impedance must be constant

Another important aspect of an antenna is the impedance behavior. For television applications it is necessary to have the antenna input impedance as nearly constant as possible over the operating frequency band. For TV broadcast this bandwidth amounts to six megacycles, and it ranges from eleven per cent of the operating frequency on channel two to about three per cent on channel 13. The allowed tolerance in impedance variation amounts to about ten per cent. A slot, like its counterpart, a dipole, is inherently a narrow band radiator. Its bandwidth for a VSWR of 1.1 amounts to about one and one-half to two per cent of the frequency when using a full-wave slot length. In this case the slot impedance behaves like that of a series resonant circuit. By canceling out this reactance variation a nearly constant resistance is obtained.

There are different methods for achieving this objective and the method which proves to be relatively simple and successful employs a half-wave section of transmission line. Its characteristic impedance has to be such that it behaves like a parallel resonant circuit. The reactance of the matcher then has an opposite slope to the reactance of the antenna and effects its cancellation. This matching principle is demonstrated on the Smith-chart of figure 2. The dashed curve represents the admittance of a full-wave slot for a given frequency band. If fed by a 77.5 ohm transmission line directly, the VSWR would be about

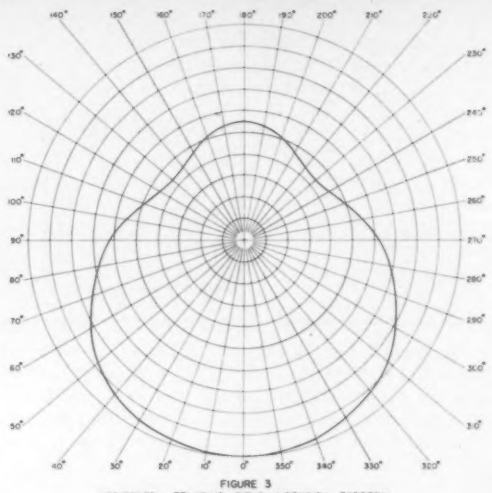


FIGURE 3
HORIZONTAL RELATIVE FIELD INTENSITY PATTERN
OF A SLOTTED CYLINDER (THEORETICAL)
D/λ = .264
CHANNEL #10

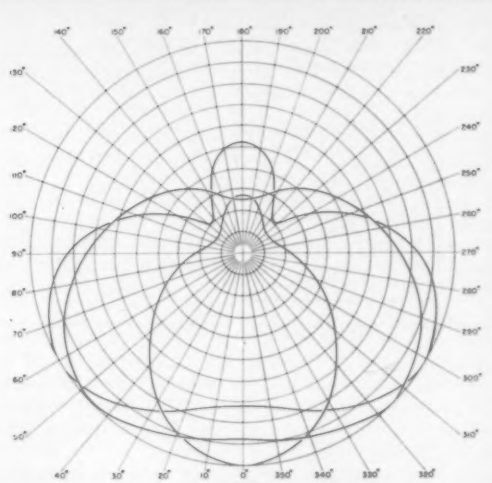


FIGURE 4
HORIZONTAL RELATIVE FIELD PATTERNS
OF A SLOTTED CYLINDER
MODIFIED BY RADIAL STUBS (D/λ = .271)

1.5. However, if a half-wave length section of transmission line with the proper characteristic impedance is inserted between the slot and the 77.5 ohm feed line, the VSWR will be reduced. The half-wave matcher in effect folds the impedance response curve into a small loop as suggested in the diagram. By this procedure, with good design, it is possible to achieve a VSWR of 1.1 over a ten per cent frequency band. Application has been made for a patent on the half-wave matcher.

Radiation patterns

The slotted cylinder antenna is of course not intended to replace the turnstile antenna because presently manufactured slot antennas do not produce the nearly omnidirectional pattern that a turnstile antenna does. Its chief advantage lies where horizontal directivity can be usefully employed. The basic field pattern produced by this antenna is shown in figure 3. Variations in design, such as the addition of radial stubs on the cylinder, allow a certain amount of modification of the horizontal radiation pattern with this antenna. This is necessary in many cases in order to meet specific coverage requirements. Some of the variations of the field pattern are shown in the illustration of figure 4. The antenna design can also be modified to provide vertical beam tilt and null fill-in suit location requirements.

Figure 1 is an illustration of a four-slot section of an eight-slot TV transmitting antenna. This particular antenna shown, was designed for CFCY-TV Charlottetown, Prince Edward Island. The stubs on the side of the slots are those which effect a modification in the horizontal pattern to suit the particular coverage requirements. The short rods are the climbing steps. All feed lines and slot matchers are mounted inside the cylinder. Compare the eight slot feeder lines of this antenna to the forty-eight batwing feeder lines of a twelve-bay turnstile antenna, yet the rms power gain is about the same for both types. With further development in this field it is very likely that new and better antennas will be produced for the television stations of the future. END

New servo system that saves the two men in a boat

Recent applications of servo and process control equipment for specialized work has resulted in the following developments:

Oil Tanker Trim Indicator: In the loading of oil tankers, it is necessary to have the load evenly distributed over the ship. Failure to do so may result in the tanker sailing from several hundreds to a few thousand tons underloaded. To ensure proper loading it has formerly been necessary for the turning-off of the loading pipelines and then for two men to go from one side of the tanker to the other, in a boat, to examine the plimsoll lines.

The new servo device, which is electronic, eliminates the two men in a boat and enables loading to be immediately adjusted while the pipelines are flowing.

Scanner detects pinholes

Pinhole Detection Unit: This system uses a special scanning system for the immediate detection of pinholes in plastics or metal strip. An adaptation enables it to be used for the examination of moulds for the casting or moulding of plastics and other materials.

Automatic arc welder

Arc Welding Control Unit: This unit automatizes the arc welding cycle of any of the existing designs. It feeds in the material between the electrodes, positions it, operates the welding head and, finally, removes the welded material.

These systems, and others, have been developed by Winston Electronics Ltd., at Shepperton, Middlesex, England whose servo department has been largely responsible for the turnover and booked orders for the first four months of 1957 totaling double the turnover for the whole of 1956.

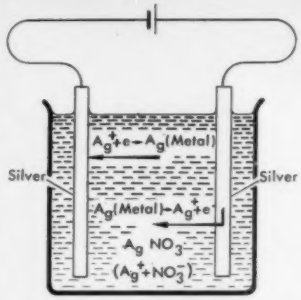


Fig. 1. A simple electro-chemical cell using similar metal electrodes

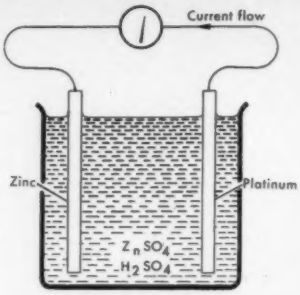


Fig. 2. The galvanic cell is a source of direct current

R. M. HURD*

Part I: Fundamentals of electrochemistry

Solion devices use ions in solution

In recent years a group of electrochemical devices has been developed utilizing electrolytic conduction. The most outstanding advantage of these new devices is their very low power consumption; much less, for example, than that required to operate a comparable transistor system. The devices may be used as fluid flow sensing elements (dc and ac), sensitive switching units, and units for taking logarithms, derivatives, etc. Part I introduces the basic principles of electrochemistry. The application of these principles will be discussed in the December issue of CEE.

All conductors of electricity may be divided into two classes, depending upon the type of fundamental particles carrying the current. The first class, metallic conductors, use only electrons to carry the current. The second class, electrolytic conductors, use ions which may possess either a positive or negative charge. An example of an electrolytic conductor is a solution of potassium iodide in water or alcohol. In this the total current carried through the solution is the summation of the individual currents carried by the positive ions moving in one direction and the negative ions moving in the opposite direction. The fraction of the total current carried by the ions of one type is called the **transference** number of that ion.

The resistance offered by an electrolytic solution to current flow is a function of several things, including the length and area of the electrolytic path, the number and type of ions present, temperature, viscosity of the solvent, etc. This can be expressed as the specific conductance, L, such that:

$$K = \frac{1}{R} = L\frac{A}{I}$$

Where K = actual conductance = the reciprocal of solution resistance R; A = area of electrolytic solution path; I = length of solution path.

The change from metallic to electrolytic conductance

In a complete electrical circuit containing an electrolytic solution the metallic portions of the circuit conduct by electrons, while in the electrolytic portion conductance is exclusively by ions. At the metal-electrolyte boundary the type of carrier must change either from electrons to ions or the reverse. This conversion from one type of carrier to another is accomplished by means of electrochemical reactions. In the cell illustrated in fig. 1 metallic silver goes into solution as silver ion, leaving an excess electron in the metal at the anode ($Ag \rightarrow Ag^+ + e^-$). At the cathode, silver ions from the solution acquire an electron from the metal and are deposited as metallic silver on the cathode ($Ag^+ + e^- \rightarrow Ag$).

It is not necessary for the material of the electrode to enter into the reaction. This condition exists when using platinum plates in a solution containing iodine and potassium iodide.

Interconversion of chemical and electrical energy:

A definite relationship exists between the amount of current passing through an electrolytic solution and the magnitude of chemical changes taking place at the electrodes. An example is the simple galvanic cell of fig. 2 which has the reaction:

At the zinc: $Zn + 2e \rightarrow Zn^{++}$

At the platinum: $2H^+ \rightarrow H_2$ (gas) $+ 2e$

The net chemical change will be:

$Zn + 2H^+ \rightarrow Zn^{++} + H_2$ (gas).

Now, by opening the external circuit and applying to the electrodes an increasing electromotive force of polarity opposite to that of the galvanic cell, the electrochemical reactions can be reduced. By increasing the electromotive force further, the electrode reactions can be made to proceed in the opposite direction, i.e.:

at the zinc. $Zn^{++} \rightarrow Zn + 2e$

at the platinum: H_2 (gas) $+ 2e \rightarrow 2H$

*Defense Research Laboratory, University of Texas

For this case, however, the platinum electrode must be surrounded by hydrogen gas, usually supplied by simply bubbling it over the surface. Here electrical energy is being converted into chemical energy, which can then be stored for future release of electrical energy.

The value of the voltage obtainable from a galvanic cell is primarily a function of the nature of the reactions occurring at the electrodes. By using different combinations of many well-known electrode reactions, a large number of galvanic cells of this type may be constructed. Furthermore, it is possible to determine the voltage produced by any given cell from a knowledge of the thermodynamic quantities (energies) involved in the net chemical reaction occurring within the cell.

Electrodes and standard electrode potentials:

To facilitate discussion the normal hydrogen electrode has been adopted as the reference standard for potential and has been arbitrarily set at 0.0000 volts at all temperatures. The hydrogen electrode can be identified as the electrode at which the reaction occurring is the reduction of hydrogen ions to hydrogen gas (or vice versa). When the effective concentration (activity) of the hydrogen ions is 1.0 normal and the partial pressure of the hydrogen gas is 1.0 atmosphere, the electrode is referred to as a normal hydrogen electrode.

The potential of any other electrode system is then defined as the E.M.F. which would be obtained from a cell consisting of the given electrode and a normal hydrogen electrode. If the components of the given electrode system are in what is referred to as their standard states, i.e., activities of solution components 1.0 molar, partial pressures of gaseous components 1.0 atmosphere, solids a single pure substance, then the potential is the standard electrode potential.

The actual potential of an electrode varies from its standard potential in accordance with the following equation.

$$E = E_o - \frac{0.059}{n} \log \frac{\text{(activity of products)}}{\text{(activity of reactants)}}$$

where n is the number of electrons involved in the reaction, and 0.059 is a constant.

From this equation, it can be shown how a galvanic potential can be obtained from two electrode systems identical in every respect other than the concentrations of the solution components. Consider the electrode system consisting of platinum metal immersed in a solution containing iodine and potassium iodide. The reactions in this case are:

at the cathode: $I_2 + 2e \longrightarrow 2I^-$
at the anode: $2I^- \longrightarrow I_2 + 2e$

If one electrode is surrounded by a concentration of iodine one hundred times as large as that around the other electrode, but both in the same concentration of KI, then a potential difference of $\frac{0.059 \log 100}{2}$ (= 0.059 volts) will exist between them. The solutions may be separated from each other by a porous ceramic plate, which hinders only slightly the electrolytic conduction, but effectively prevents mixing of the solutions.

Conversely, it can be seen that if identical solutions are placed in both sides of such a divided cell, the application of an external voltage will transfer the iodine from one side to the other. That is, iodine will be reduced to iodide in the cathode side, and iodide oxidized to iodine in the anode side. It is also important to point out that in a cell of this type, no net chemical change occurs in the solution so that it is not consumed, but will last indefinitely.

An electrode which can function like the iodine electrode described above, i.e. exactly equal but opposite chemical reactions for equal but opposite current flows, is called a reversible electrode. There are three types: the first consists simply of a metal dipping into a solution of its ions (the silver/silver ion electrode). The second type consists of a metal in contact with one of its insoluble salts immersed in a solution of a soluble salt of the same anion, (the silver/silver chloride in dilute potassium chloride). The third type, commonly called a redox electrode, consists of an unattackable metal, usually platinum, immersed in a solution containing forms of the same chemical in two different oxidation states (the iodine-iodide electrode system).

Overvoltage, polarization, and polarography.

If the potential of an electrode in a galvanic cell is measured at the point of zero current flow, the value so obtained is called the reversible potential. Now if an increasing current is forced into (or out of) the electrode, a point will be reached at which the measured potential begins to change from the reversible potential. The value of current at which this occurs is a function primarily of the type of electrode and the area through which the current is flowing. The amount of this deviation (in volts) from the reversible potential is called the overvoltage, and the electrode in this condition is said to be polarized. Overvoltage results from the slowness of one or more of the processes occurring at the electrode, so that overvoltages are classified according to the nature of the slow process. The first type, activation overvoltage, results from the slowness of the chemical reaction itself; an example of this is encountered when sulphide is added to the electrolytic cell. The sulphide, which is absorbed on the platinum electrodes "poisons" the cathodes for the reduction of hydrogen ion, so that a high overvoltage for evolution of hydrogen is obtained, effectively preventing this interfering reaction. The second type, concentration overvoltage, results from the slowness of diffusion of the reacting species to the electrode surface, so that a concentration gradient arises near the electrode. Many of the electrochemical elements of the acoustic detector function through the concentration overvoltage of iodine at the cathode of these cells. This type of overvoltage is often referred to as concentration polarization.

Another source of deviation from the zero current potential arises when, for any reason, an insoluble film forms over the electrode surface, thereby blocking the supply of reacting ions. This is sometimes called film overvoltage, although in reality it is of the nature of a pure resistance inserted in the circuit, with a consequent IR drop.

Because of the very important part played by concentration polarization in the electrolytic mechanisms, it will be described in somewhat greater detail. Consider a cell consisting of two pieces of platinum immersed in a solution containing iodine and potassium iodide. If there are no differences in concentration through the solution, each piece of platinum will be at the same value of potential, so that if they are externally connected, no current will flow. However, if an external source of E.M.F. is applied to the electrodes, the system becomes an electrolysis cell, and current will flow with the reduction of iodine at the negative electrode (cathode) and the oxidation of iodide at the anode. The value of the current at any given value of applied E.M.F. is controlled by one of the following three factors, assuming no activation or film overvoltage:

(a) Electrolytic resistance through the solution.
(b) Supply of iodide ion to the anode.
(c) Supply of iodine to the cathode.

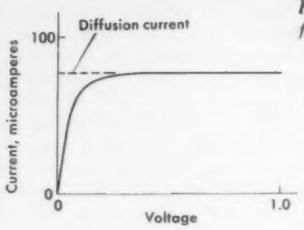


Fig. 3. Typical current-voltage curve for concentration polarization

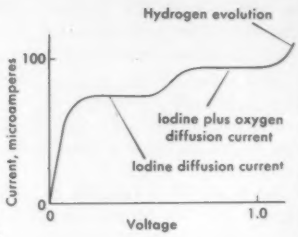


Fig. 4. Current-voltage curve for iodine-iodide cell containing oxygen

By adding a large excess of potassium iodide to the solution and using a large area anode, effects (a) and (b) may be minimized so that the current will be regulated solely by the supply of iodine to the cathode. In a quiescent solution the rate at which iodine reaches the cathode is governed by a diffusion process, the laws of which are well known. A plot of current vs voltage for such a system is shown in fig. 3. The value of current on the flat portion of the curve is called the diffusion or limiting current, and is proportional to the area of the electrode, the concentration of iodine in the solution, and the diffusion "coefficient" of the iodine.

Diffusion currents can be obtained for a large number of chemical species in addition to iodine, and since the diffusion current is proportional to the concentration of the species, this has been made the basis of an analytical technique called polarography. Furthermore, the value of the electrode potential at which the species is reduced depends upon the known standard electrode potential of that species, so that a qualitative as well as a quantitative analysis can be obtained from a single current-voltage curve.

If more than one of the chemical species in a solution are capable of being reduced at a given potential, then both (or all) reductions will proceed simultaneously when that potential is reached. See, for example, fig. 4, which is a current-voltage curve for an iodine-iodide cell containing dissolved oxygen. The oxygen reaction in this case is not reversible (nor is the later evolution of hydrogen), so that the only reaction occurring at the anode is oxidation of iodide to iodine, not balanced by an equivalent reduction of iodine at the cathode. The end result is a gradual increase in iodine concentration, and it is for this reason that oxygen must be excluded from the cell, and the hydrogen evolution reaction prevented.

The manner in which concentration polarization is used in a fluid flow detector is simple. Since the value of current is controlled by the rate at which iodine reaches the cathode, the current increases when the supply of iodine to the cathode is increased. This is accomplished by either disturbing the solution, thereby upsetting the diffusion layer, or by pumping a concentrated iodine solution over a cathode surrounded by a dilute solution. In a flow detector, the solution is "disturbed" (forced back and forth through a cathode in the shape of an orifice) by the fluid flow that one desires to detect. In a dc flow detector a concentrated solution is "pumped" over a cathode. In the derivative devices and product devices, the pumping is accomplished by means of another electrolytic unit, the osmotic cell.

Electrokinetic phenomena and the electro-osmotic cell

At the boundary of a solid and a solution, there exists a distribution of charged particles (ions) called the electrical double layer. Using a glass surface in contact with a dilute water solution as an example, this ionic distribution arises as follows: Due to unbalanced electrical forces, the glass surface possesses a net negative charge, to which the positive ions in solution are attracted. The large majority of these positive ions are tightly bound to the surface; that is, they are no longer free to move relative to the solid. However, a small percentage of these ions are distributed a bit further into the solution than are the fixed ions, and are movable with respect to the solid (fig. 5). Note that this double layer of charge distribution is analogous to a charged parallel plate condenser, and many of the theoretical calculations on double layer effects are made on this basis. However, the potential drop perpendicular to the surface of the solid is not as sharp and well defined as in the parallel plate condenser, (fig. 6), but tails off into the solution through the region of movable ions. The potential drop through this region is called the zeta potential, and it is with this potential that all electro-kinetic phenomena are concerned. For this discussion, it is of most importance to remember that a certain portion of solution, movable with respect to the solid, contains (in this case), a *net positive*

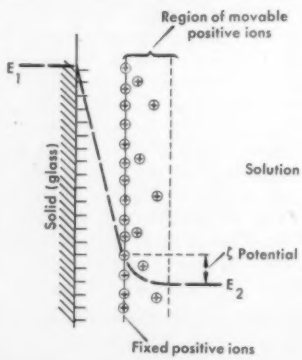


Fig. 5. Potential drop and charge distribution in electrical double layer

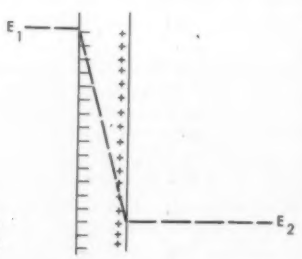


Fig. 6. Potential drop and charge distribution in parallel plate capacitor

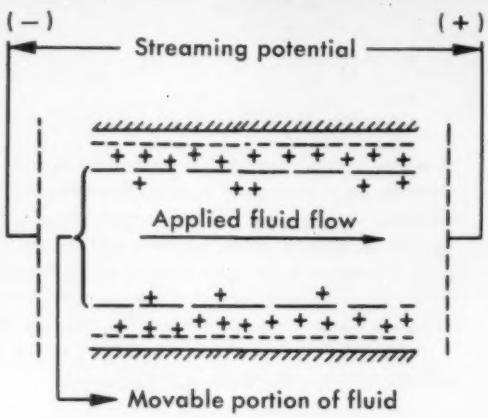


Fig. 7. Origin of the streaming potential

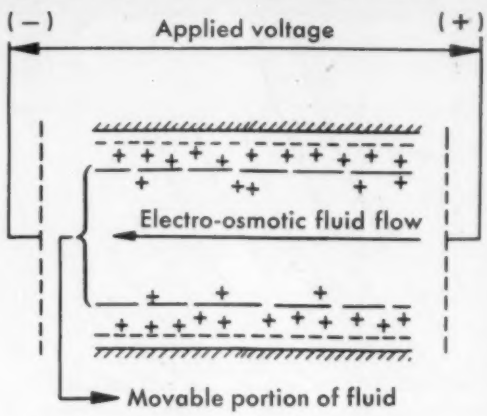


Fig. 8. The origin of electro-osmosis

charge. In electrokinetic experiments, the region containing this net charge must be made a significant fraction of the total solution. This is accomplished by means of capillary tubes (large surface to volume ratio), or by fritted glass discs, which are nothing more than a large number of irregularly shaped capillary tubes in parallel.

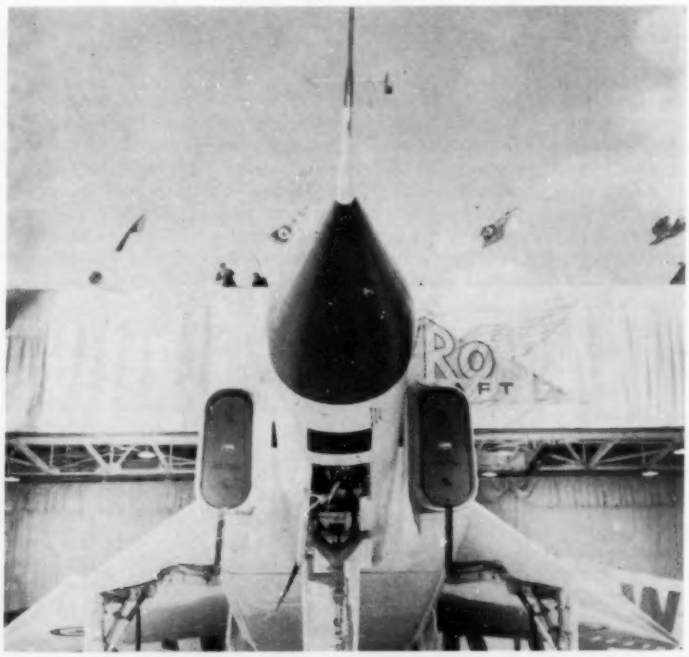
In fig. 7 an electrical double layer is shown on the inside of a glass capillary tube, with electrodes placed at the ends of the tube. Note that if (as in fig. 7) the fluid is forced through the tube by means of an applied hydraulic pressure, the region containing excess positive charges will be carried along, creating a potential drop from one end of the tube to the other. This phenomenon is called streaming potential, and the magnitude of the streaming potential is directly proportional to the applied hydraulic pressure.

Conversely, if instead of an external hydraulic pressure, an external potential is applied to the two electrodes, the solution will be carried down the tube toward the negative electrode by the movement of the excess positive ions (fig. 8). This movement of fluid under the influence of an applied voltage is called electro-osmosis. If the fluid is allowed to flow freely through the tube, the rate of flow will be directly proportional to the applied voltage; if the fluid flow is restrained, then hydraulic pressure will be developed across the tube, and the value of this pressure will be directly proportional to the applied voltage.

The flow rates and pressures obtainable at around one volt applied potential across a fritted disc are rather small, in the range of 10^{-3} to 10^{-5} cubic centimeters per second for flow rates, and 5 to 10 centimeters of water in the case of pressure build-up.

Of these two phenomena, the only one of interest here is electro-osmosis, which is used to make the low-voltage fluid pump employed in the derivative and product units.

END



Avro's new Arrow

Canada's newest fighter rolled off the production line last month and is now undergoing pre-flight tests. The delta-winged CF-105 is a tribute to the skill of the engineers and production people at Avro Aircraft Ltd. At the design speed of 1,200 mph, the Arrow is on the threshold of the heat barrier where friction raises the temperature of an aircraft's skin by 300 degrees F.

No details have been released on the comprehensive electronic flight control system, but it requires little imagination to visualize some of the equipment needed to guide an aircraft to its target, deliver its load—rockets, bombs or reconnaissance equipment—then return it to its base. At 1,200 mph, the pilot can do little more than exercise rational judgment under certain conditions.

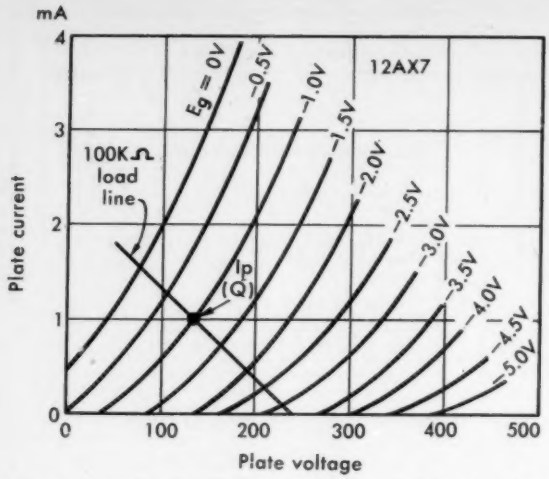


Fig. 1. 12AX7 characteristics with chosen working point

Analysis of the cathode coupled amplifier shows there to be a systematic relationship between the nearness to equality of the output signals, the degree of common mode rejection and the over-all gain. Equations have been derived which, together with the characteristics of the tubes being used, reduce design to a straightforward procedure. This is made even more rapid by the use of nomograms which represent the important equations.

Nomograms simplify design of cathode coupled amplifiers

A. E. MAINE*

The cathode coupled amplifier may be regarded basically as a phase-splitter, or an inverter, or as a means for obtaining a balanced push-pull output when operating from a single-ended signal source. The amplifier, which is directly coupled and responds down to zero frequency, has the property of discriminating strongly against noise pickup. It is thus very useful in the early stages of high gain amplifier systems. There are four modes of operation of the amplifier:

(a) Signal to grid 1; grid 2 at fixed potential
(b) Signal to grid 2; grid 1 at fixed potential
(c) Push-pull signal applied to both grids
(d) Common signal applied to both grids

In the first three cases it is generally required that the two plate signals be of very similar magnitude—but of opposite sign—and symmetrical about some point between B+ and B—. In the fourth case the output signals are required to be as near to zero as possible.

Analysis of the amplifier circuit shows there to be a systematic relationship between the nearness to equality of the output signals, the degree of "common mode rejection" and the over-all gain. Equations show that the higher the value of the common cathode resistance the more nearly does the amplifier behave in the ideal manner. Design becomes a straightforward matter of evaluating certain equations and checking working points on tube characteristics. The important equations and the relevant circuit schematics are given in the table, and in order to simplify the procedure and enable solutions to be obtained rapidly, the nomograms of figures 2, 3 and 4 may be used.

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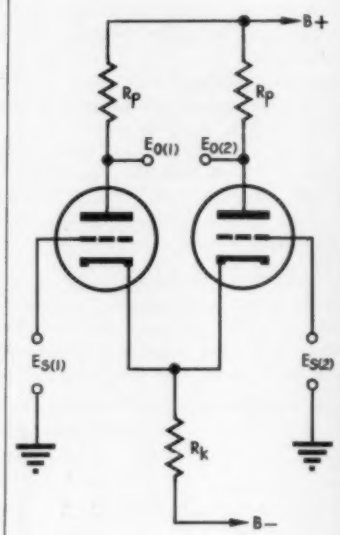
DESIGN METHOD

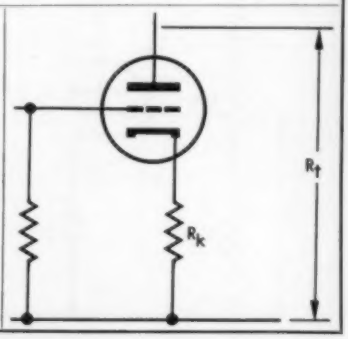
In order to show the method of design and illustrate the use of the nomograms, a solution is worked through for the following design specification:

Purpose:	Single-ended to push-pull amplifier for feeding a high impedance input driver stage.
Gain:	For single-ended signal, 25 or greater per plate.
Deviation:	Plate signals to be matched to within 1% for single-ended operation.
Design Objective:	Assuming that a 240 volts B+ supply is available, to find the negative rail voltage required and to deduce all circuit component values.

CATHODE COUPLED AMPLIFIER EQUATIONS

QUANTITY	EQUATION	CIRCUIT
GAIN	For push-pull signals $G = \frac{E_o \text{ (plate-to-plate)}}{E_s \text{ (applied to one grid)}} = \frac{\mu R_p}{R_p + r_p}$ ..... (1a) For single-ended signals where $R_k \rightarrow \infty$ $G' = \frac{E_o \text{ (one plate only)}}{E_s \text{ (applied to one grid)}} = \frac{\mu R_p}{2(R_p + r_p)}$ ..... (1b)	
DEVIATION	$D = \frac{1}{1 + \frac{2(\mu + 1)S_1}{S_2 + 1}}$ ..... (2) where D = deviation from true push-pull (positive for one plate signal, negative for the other) μ = tube amplification factor S_1 = ratio $\frac{\text{cathode load resistance}}{\text{plate resistance}} = \frac{R_k}{r_p}$ S_2 = ratio $\frac{\text{plate load resistance}}{\text{plate resistance}} = \frac{R_p}{r_p}$	
COMMON MODE REJECTION	$J = \frac{E_o \text{ (either plate signal)}}{E_s \text{ (common grid signal)}} = DG$ ..... (3) where J = gain for common mode signals D = deviation fraction G = normal gain	

CATHODE FOLLOWER EQUATION

TOTAL RESISTANCE	$R_t = r_p + R_k(\mu + 1)$ ..... (4) where R_t = resistance between plate and negative end of cathode resistor r_p = plate resistance R_k = cathode load resistance	

Step 1—Quiescent working point

Since a fairly high stage gain is specified and a voltage rather than a power output is required, a suitable choice of double triode tube is the 12AX7 which has a μ of 100 and a plate resistance of 80,000 ohms. A favorable working point Q is chosen from the published tube characteristics which as shown in figure 1 corresponds to:

$I_p = 1.0$ ma $\quad E_p = 140$ v $\quad E_g = -1.0$v

Step 2—Plate load resistance

The chosen working point leaves 100 vdc across the load resistor, so that with the stated plate current the load resistance becomes 100 K.

Step 3—Plate-to-plate gain

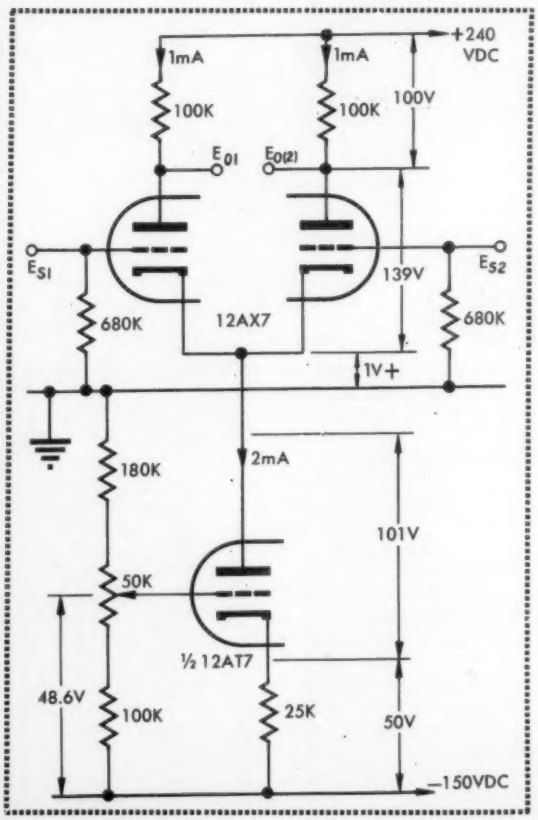
The ratio of plate load resistance to plate resistance is 1.25. This point is located on scale A of figure 2 and a straight-edge is set to join this point to $\mu = 100$ on scale E. The over-all gain is read from scale C at the intersection with the straight-edge and is found to be 56. If R_k is assumed to be large, the gain per plate is 28, which is satisfactory.

Step 4—Deviation

The nomogram of figure 3 is used to find the value of R_k to give a deviation of 1% as follows:

A straight-edge is set between 100 on scale C and $S_2 = 1.25$ on scale E. An intersection is noted on the central reference line D. From this point the straight-edge is re-positioned to align with 1% on scale A. The answer appears on scale G at the intersection with the straight-edge and is $R_k/r_p = 1.11$, hence $R_k = 89$ K.

If no claim had been made for any particular value of common mode rejection, a resistor of the value just calculated could be used in the common cathode circuit. Since both tube currents pass through it the voltage drop would be about 180 vdc, which is not excessive.



Step 5—Common mode rejection

Using equation (3), the gain for common mode operation is immediately determined as J = 0.56 (common mode signal of 1 volt gives an output change of 0.56 volts). A similar single-ended signal gives one signal of 28 + 0.28 volts and a second one of —28 + 0.28 volts. The discrimination between the wanted signal and the unwanted common mode one is 50: 1, or 34 db.

Suppose that the common mode rejection required of the amplifier corresponded to no more than 0.1 v plate voltage change for a common 3 v grid signal. The value for j is obviously 0.033. Using equations (2) and (3), it is necessary to calculate a new value of R_k in the way described under Step 4. The results are: deviation = 1% and required cathode resistance = 1.5 Meg. It is obvious that such a high-valued resistor cannot be connected directly into the cathode circuit because of the prohibitive standing voltage drop across it. However, a cathode follower may be used as a "tail" tube since this can offer a very high effective resistance without an excessive voltage drop.

Step 6—Design of cathode follower

A half-section of a 12AT7 tube is a suitable choice, and the following working point is selected:

$I_p = 2.0$ ma $\quad E_p = 100$ v $\quad E_g = -1.4$ v

From the published tube parameters, $\mu = 60$ and $r_p = 17{,}000$ ohms. Turning to the nomogram of figure 4, the value of the cathode follower cathode resistance which gives the required total resistance of 1.5 Meg. is quickly determined. The straight-edge is set between 1.5 Meg on scale B and 17 K on scale E. An interesection is noted on the reference line A. From this point the straight-edge is moved to align with 60 on the μ scale C. The required cathode resistor value is read from the intersection of the straight-edge with scale D and is 25 K.

Step 7—Circuit diagram and component values

The previous steps have supplied all the important design data enabling the complete circuit diagram opposite to be drawn. Since the circuit currents and quiescent tube voltages are known, a moment's calculation establishes the required negative rail voltage at —150 vdc, and gives the values of the resistors required for the cathode follower potential divider. A pre-set control is incorporated into the bias chain to allow the stage to be correctly set up.

CONCLUSIONS

A striking feature of the amplifier described is its discrimination against hum pickup, which may be expected to operate the stage in common mode. For example, a ½-volt signal applied in common mode gives only 16 mv output, whereas the same signal applied only to one grid yields an output of 14 volts per plate. The rejection ratio is evidently 875 : 1, or 58 db. In practice it is unlikely that such a figure would be obtained due to the presence of non-linearities and mis-matching of the tube characteristics. Nevertheless, a value approaching the calculated figure should be obtained with well-matched tubes and a careful physical layout in which the input and output circuits are well screened from each other.

The foregoing example shows that the design of cathode amplifiers is simple and straightforward, and the nomograms useful because several trial calculations may be carried out in a few minutes, enabling the best operating conditions to be rapidly determined. END

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2. *Parker: "The Cathode Follower," Electronic Engineering, January 1948, page 12; February 1948, page 55; March 1948, page 92; April 1948, page 126.*

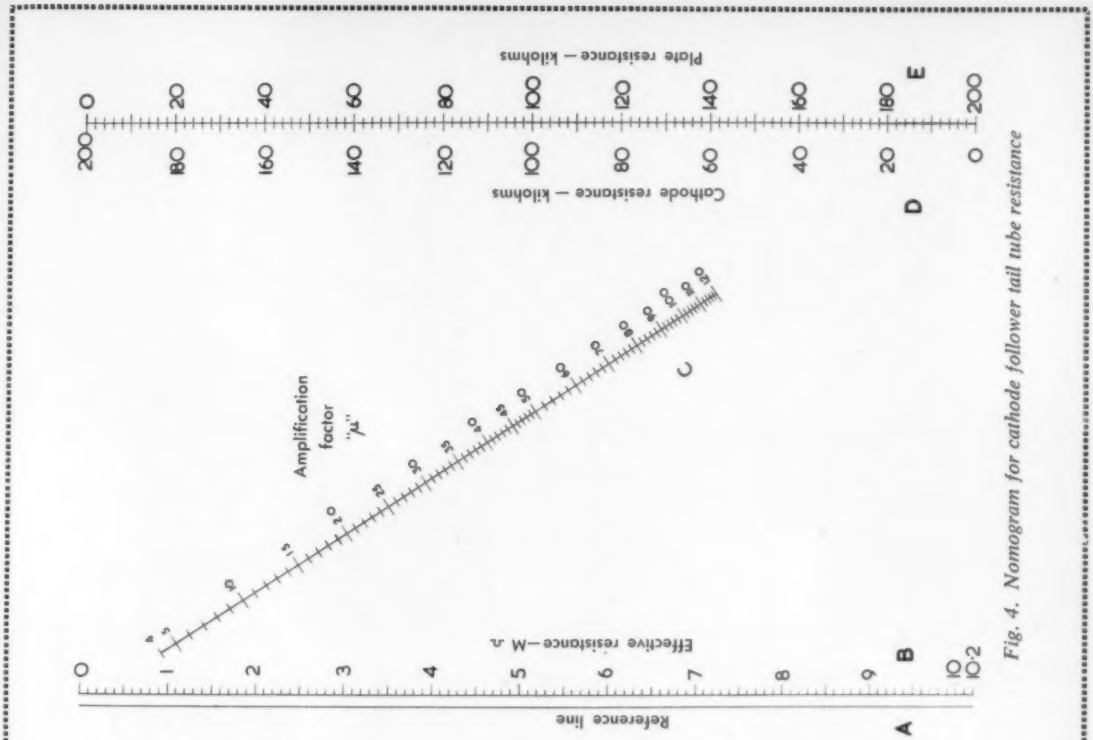


Fig. 4. Nomogram for cathode follower tail tube resistance

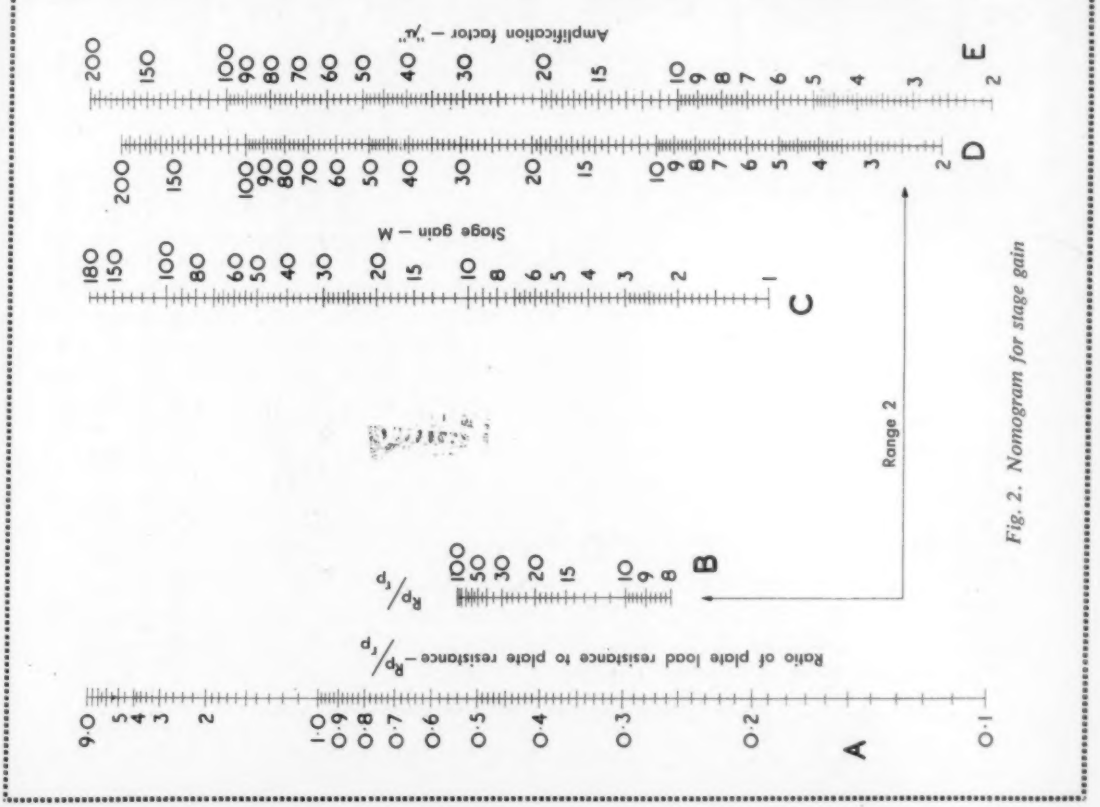


Fig. 2. Nomogram for stage gain

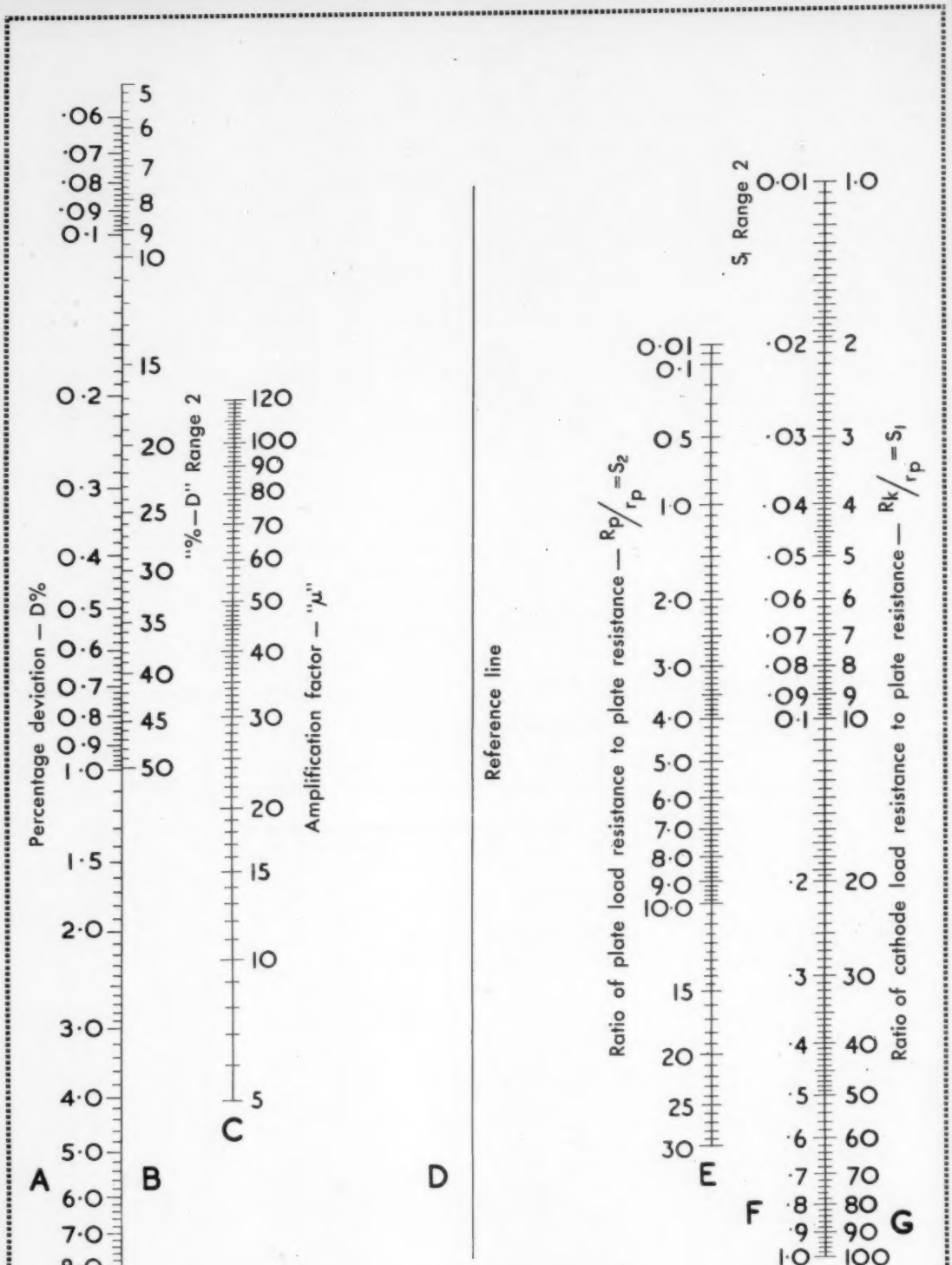


Fig. 3 Nomogram for percentage deviation (D%)

To test possible interference effects on narrow band operation, the radios were used side by side on adjacent channels

Tests prove narrow band mobiles can solve overcrowding

D. RODDY*

With the greatly increased use of mobile communication equipment, the available bands have become crowded. One solution is to use narrow band equipment. This report describes new 30 kc and 15 kc bandwidth transmitter-receivers plus the extensive tests which were carried out under operating conditions to prove lack of interference on adjacent channels.

Allocation of "split channels" has long been talked about as one method of easing congestion in the 147-174 mc communications band. Equipment has now been developed which will allow 30 kc same area performance equal to or better than that given by present 60 kc channel spacing equipment. With only small modifications, this new equipment will also allow 15 kc channelling, some increase in geographical separation being necessary for this latter spacing.

The tests described here were made to demonstrate the equipment's effectiveness under practical conditions. The interference products looked for in the tests were those caused by (a) direct adjacent channel breakthrough, (b) 3rd order intermodulation products, (c) cross modulation, and (d) desensitization. A further test was made to show the effect of a low deviation fm transmission on an adjacent 30 kc a-m system.

*Pye Canada Limited, Toronto.

Equipment used

Pye type PTC-724YV a-m base stations were used, with 15 watts nominal rf output, unmodulated. Modulation limiting is employed on these to prevent excessive sideband radiation. High audio frequencies produced by speech and by limiting action in the modulator tubes are severely attenuated by a filter, and the modulation on the p-a tube is limited to approximately 80%. This prevents nonlinearity in the p-a from producing unwanted sidebands directly, as these would be extremely difficult, if not impossible to reject with a filter.

The frequency accuracy and stability of the base station equipment, taking into account all sources of error such as ambient temperature variations (—30C to +60C), voltage variations (±10%), ageing of crystals and circuits, and the i-f drift in the case of receivers, is approximately ±0.0008% for the transmitter, and ±0.002% for the receiver. The transmitter and receiver 1st oscillator crystals are oven controlled. These figures are derived assuming that all sources of error act together in one direction; it is also assumed that the equipment will be periodically renetted to frequency in service.

Two type PTC-3/2002YV and one type PTC-2002YV

a-m mobiles were used for the 30 kc tests, the difference between these models being that the former can be switched to any one of three channels, while the latter is a single channel mobile. Power output is 5 watts nominal, unmodulated. These employ modulation limiting similar to that on the base station. The mobile equipment frequency accuracy and stability is approximately ±0.0023% for the transmitters and ±0.0035% for the receivers.

The above figures were derived by the same method as that used for the base station.

Oven control was not used, however, as the system was considered to be essentially a base to mobile (and vice versa) operation, and not including mobile to mobile. If the latter case was to occur frequently, it would then be necessary to use oven control on the mobiles, giving these the same over-all accuracy and stability as the base stations.

The 15 kc receivers (base and mobile) have additional i-f transformers to give the necessary adjacent channel rejection at 15 kc. The mobile receiver also has 1st oscillator crystal oven control. Otherwise the 15 kc receivers are identical to the 30 kc receivers. Except for oven controlling the 15 kc mobile transmitter, the transmitters in the two systems are identical.

The fm base station was a type PTC-8701/2YV. This gives 20 watts nominal rf output and is phase modulated. High audio frequencies are attenuated, and deviation is limited to 5 kc for 30 kc channel operation. The frequency accuracy and stability is the same as the a-m base station.

The over-all design of the equipment incorporates modern circuit techniques and component advances which enable it to overcome some, and substantially reduce other, interference problems. Low-gain grounded grid amplifiers are used in the rf stages, having low voltage gain consistent with a good noise factor. This, coupled with the use of rf amplifier and mixer tubes having a good degree of linearity reduces intermodulation and cross modulation interference to a very low degree. The superior adjacent channel selectivity is due to the advanced design of the i-f transformers as well as the frequency stability provided by close tolerance A.T. cut crystals and use of miniature crystal ovens as discussed previously. The i-f transformers mentioned are encapsulated units using ferrite coils and small highly stable capacitors. These provide the necessary selectivity in a small size, and with the required degree of stability. The i-f amplifier, having six transformers, has a nosewidth of 12 kc, a bandwidth factor of 3, and a frequency drift not exceeding 1 kc.

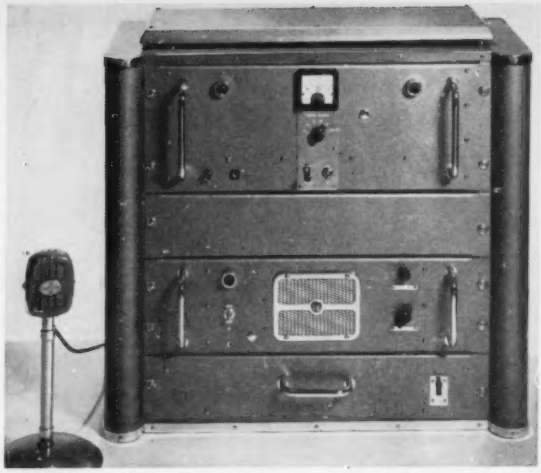
Noise limiters are used in the receivers which provide a high degree of freedom from impulse noise, even though the narrower bandwidth increases the receiver's susceptibility to this type of interference. Inherent receiver noise is reduced in direct proportion to receiver bandwidth and the narrow band receiver is noticeably quieter than the 60 kc counterpart.

As mentioned, the transmitters employ modulation limiting with subsequent filtering. The over-all system, i.e., including transmitter and receiver, therefore requires much less spectrum bandwidth, and a marked advantage is that the good audio quality inherent in properly designed a-m equipment is maintained even though less bandwidth is being used.

Adjusting the equipment

The transmitters were netted (by means of a trimmer in the crystal circuit) to a frequency standard accurate to ±0.0001%. The receivers were also netted to this standard, but in addition used a crystal controlled oscillator at i-f to obtain zero beat.

All receivers had their squelch controls set at normal operating level, which is about 0.5 microvolt. In some tests, however, the mobile receiver squelch was made inoperative, the receiver then being in its most sensitive condition. This is mentioned in the tests where applicable.



AM base stations for tests were rated at 15 w nominal rf output, unmodulated. Frequency stability was ± 0.0008%

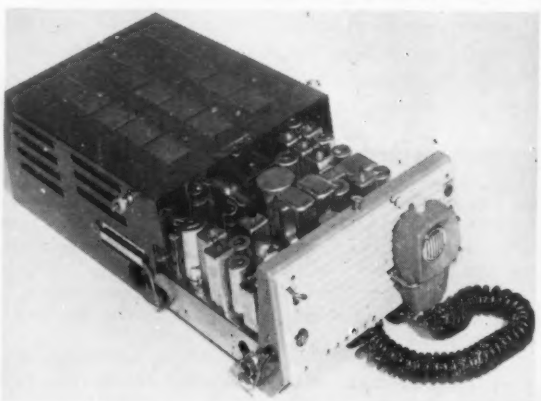
The mobile equipments operated into quarter-wave roof-top antennas, and the base stations into quarter-wave ground-plane antennas. Further details of the base stations, shown on the map as 1, 2 and 3 are:

1. Operated as any one of—
   Channel 1, F_a = 161.115 mc a-m.
   or, Channel 1.5, F = 161.30 mc a-m.
   or, Channel 4, F_d = 161.205 mc fm.
   Antenna elevation, 590 feet asl.
2. Operated as channel 2, F_b = 161.145 mc a-m.
   Antenna elevation, 580 feet asl.
3. Operated as channel 3, F_c = 161.175 mc a-m.
   Antenna elevation, 520 feet asl.

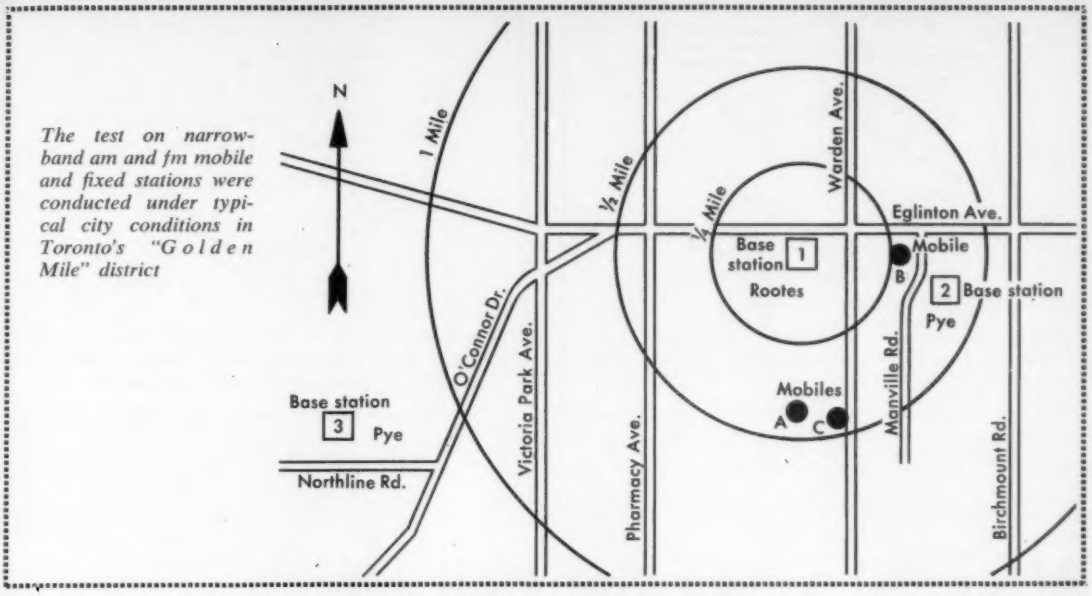
30 kc AM system tests

1. Routine check: The three mobiles readezvoused at point A and established contact between mobiles and fixed stations. The two multichannel mobiles switched to all channels and found the interchannel crosstalk to be negligible.

2. Direct adjacent channel interference (mobile to mobile): Using mobiles 1 and 2 (both multichannel) at point A, mobile 1 first transmitted on channel 2 while mobile 2 listened on all channels in turn. Similarly, mobile 2 transmitted on channel 2 while mobile 1 listened on all three channels in turn. The mobiles were less than five



The mobile radios were rated at 5 watts nominal. Mobile and station radios were designed for 30 kc channel width



The test on narrow-band am and fm mobile and fixed stations were conducted under typical city conditions in Toronto's "Golden Mile" district

yards apart during the test without interfering with each other.

3. Intermodulation interference: With mobiles at A, base transmitters 1 and 2 transmitted while mobiles 1 and 2 observed intermodulation product on channel 3. This was weak but not negligible. Test 4, however, showed that this point was close to the limit of the interference area.

There was no cross modulation interference between channels 1 and 2 at this point.

4. Limit of intermodulation area: This test was carried out at a distance approximately 100 yards west of point A and the interference on channel 3 disappeared. The test was repeated with the squelch inoperative, but again no interference was observed.

5. Cross modulation and intermodulation: This test was carried out at point B where field strengths of base stations 1 and 2 were large and approximately equal. The field strength of station 3 was relatively small.

With transmitter 2 modulated, mobiles listened on channel 1 and observed the cross modulation as the carrier of transmitter 1 was periodically switched.

With transmitters 1 and 2 both modulated, mobiles observed the intermodulation product on channel 3 (this carried both modulations). Station 3 then transmitted a carrier which produced a heterodyne whistle on channel 3.

Both types of interference were quite strong at this point. A further test was made with the squelch removed to ensure that the interference was not partly masked by direct adjacent channel breakthrough, or desensitization. Neither of these effects could be observed.

6. Direct adjacent channel interference (base to mobile): With mobiles at station 1 but tuned to channel 2, the station transmitted on channel 1. The test was repeated with the squelch inoperative. In both cases no interference was observed.

15 kc A-M system tests

Intermodulation and cross modulation tests were not repeated since they are independent of channel spacing.

7. Direct adjacent channel breakthrough (mobile to mobile): With two mobiles beside station 1, mobile 2 transmitted on channel 2 while mobile 1 listened on channel 1.5. This was repeated with mobile 2 transmitting on channel 1.

For this test the mobiles drove slowly away from each other until interference ceased—a distance of approximately 200 yards.

8. Direct adjacent channel (base to mobile): A mobile was set to listen on channel 1.5 and moved away from station 1 while the station transmitted on channel 1. Point C represents the limit of adjacent channel interference from the station.

FM test

9. Direct adjacent channel breakthrough (fm base to a-m mobile): With an a-m mobile located beside station 1, no interference was detected when listening on channel 3, while the base station fm was transmitting on channel 4. When the squelch was made inoperative some noise was heard from the fm transmission and was attributed to sideband noise.

Conclusions

It was shown that adjacent 30 kc a-m systems operating in the same area were quite practicable. There was no interference from adjacent channel breakthrough. In fact, intermodulation, which is independent of channel spacing, was one of the limiting factors; since this equipment embodied the latest design techniques to reduce intermodulation, the performance was better than that at present obtained from many 60 kc systems.

The 15 kc tests showed that such a system would be practicable, but adjacent channels would require some degree of geographical spacing. Channel allocations on a 15 kc basis, therefore, would require careful study by the appropriate licensing authority.

Direct adjacent channel interference caused in an a-m system by a 30 kc adjacent fm system was found to be negligible. More comprehensive tests would have to be made, however, to full assess interference problems caused in adjacent channel dissimilar systems.

Finally, it is felt that 30 kc equipment (operating on 60 kc channels) could be introduced now into existing 60 kc systems, as this would considerably simplify the future changeover to 30 kc spacing. Some compatibility problems within the 60 kc system will arise, but can be overcome with reasonable technical planning. The successful operation, however, of 30 kc equipment in any system will require the use of accurate test equipment and well-trained personnel to periodically check frequency and to do general maintenance on the equipment. END

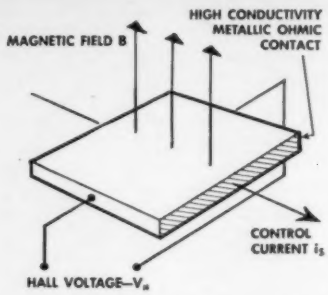


Fig. 1 The control current is at right angles to the magnetic field B, produces a voltage V_H in a polycrystalline Hall generator.

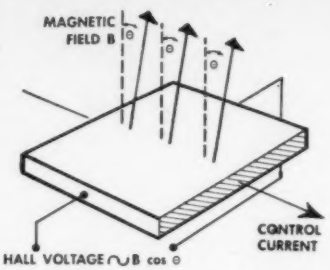


Fig. 2 If a magnetic field penetrates the Hall generator at some angle other than 90 degrees, output is a function of displacement angle and magnetic field.

After 80 years the Hall effect is being put to work

T. R. LAWSON, Jr.*

The Hall effect, though interesting scientifically, apparently had no practical significance when it was first noted by Professor Hall in 1879. Until fairly recently it remained a scientific phenomenon. Now, with increased knowledge of semiconductor materials it has practical applications. Devices being developed show promise as analog computer elements and could revolutionize methods now being used for measuring some electrical quantities

If a conductor carries a current at right angles to a magnetic field, a charge difference is generated on the surface of the conductor in a direction which is mutually perpendicular to both the field and the current. This is the so-called Hall effect, discovered first in 1879. Until recently this was largely a laboratory phenomenon; now, with the increased knowledge of semiconductor materials, practical, and valuable applications loom on the horizon.

The intermetallic semiconductors indium-antimony and indium-arsenic have properties that make a practical application of the Hall effect possible; in fact, technically usable circuit elements from these materials, called Hall generators, have been developed (fig. 1). With most metals, the voltage produced by such a device is in the vicinity of one microvolt. Some of the semiconducting compounds, however, have outputs of one or more volts, with sufficient power to operate a sensitive relay. Such a device has many possible applications.

The Hall generator is essentially a device that provides a voltage output proportional to the product of two quantities—(a) the current being fed to it, and (b) the magnetic field perpendicular to it. This permits many novel applications in measuring circuits and equipment design.

A carefully designed and built Hall generator can have an output exactly proportional to the product of the magnetic field strength and the current. This product formation suggests uses as an analog computer element. A Hall generator can be used, for example, to multiply directly two electrical quantities. One of these electrical quantities is expressed as a current and the other electrical quantity is expressed as a magnetic field. The maximum

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frequency at which the above considerations are true can be from 10^{13} to 10^{14} cycles.

Similarly, an electrical quantity can be squared by such an analog element. The quantity to be squared is simply expressed both as a field and as a current. Under these conditions application of the electrical quantity to the input of the device will yield a Hall voltage proportional to the square of the input parameter.

If the magnetic field penetrates the Hall generator at some angle other than 90 degrees, the output of the Hall generator is proportional to the magnetic field times the cosine of the angle between the normal to the Hall generator plane and the magnetic flux lines (fig. 2). This method gives a very precise and simple method for obtaining an electrical analog of the cosine or sine of a mechanical rotary displacement. This analog automatically goes through zero and produces polarity reversals in different quadrants.

Use as a position indicator

This type of Hall generator can also be used as a position indicator (fig. 3). A magnetic field is set up

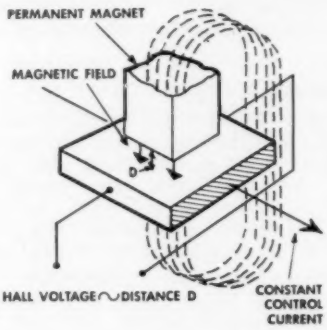


Fig. 3 If constant control current is sent through the Hall generator, output is a function of the distance of the permanent magnet pole from the generator. This setup can thus be used as a distance indicator.

and a constant control current is sent through the generator. The output of the generator will be some function of the distance of the generator from the magnetic pole. In this way the generator can act as an indicator of position. Obviously, since the output of the Hall generator is exactly proportional to the magnetic field, this device can be used as a simple and portable method for probing magnetic fields. In this application the Hall generator would be made extremely small in size to obtain a high degree of accuracy in plotting the magnetic field. These devices are also used to measure a uniform magnetic field and to observe its fluctuations with time.

If a Hall generator is placed in the air gap of a split C yoke (fig. 4), it is possible, by placing the yoke around the bus bar, to measure high bus-bar currents without breaking the current path and without many of the inherent difficulties with the present measuring apparatus. High current measuring devices have been developed along these lines which allow extremely high precision for this type of measurement and at the same time offer the convenience of not having to break the high current circuit.

Because of their extremely fast response time Hall generators can be used to measure the power content of transients. In plots of fuse blowout or lightning arrestor

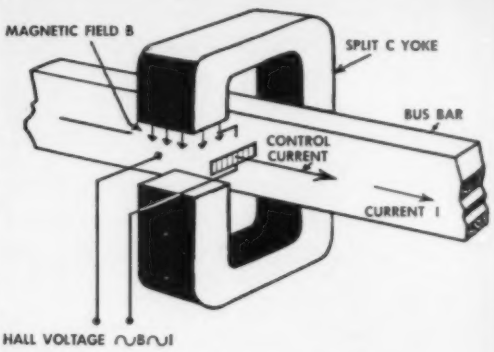


Fig. 4 By use of a split C yoke, a Hall generator can also be used to measure bus bar current as shown

breakdown the current and voltage surges do not coincide. To calculate the maximum power developed in the device during a fault, the appropriate voltage and current curves are multiplied, point to point. The fault voltage or a proportional fraction thereof is impressed on a Hall generator and the fault current generates a magnetic field. The Hall voltage then generates a trace on an oscillograph that is the product of these two and thus is proportional to the power content of the fault pulse. This method, of course, is considerably faster and nearly as accurate as point-by-point plotting methods. By similar circuitry, an economical wattmeter having no moving parts can be devised. This wattmeter would automatically give a true indication of wattage regardless of the power factor of the load.

Output impedance very low

Hall generators have been used to measure the internal torque of d-c motors. This is done in one of several ways. One of the most common is to place the Hall generator in the air gap on the surface of one of the pole shoes. A current proportional to the armature current is fed through the Hall generator. Since the internal torque of a d-c machine is proportional to the product of the armature current and the flux density in the air gap, the output of the Hall generator is also proportional to the internal torque of this machine. By placing the Hall generator on the armature rather than on the pole shoe, the actual variations in magnetic flux can be determined as a function of rotation of the armature. These facts make possible design improvements of an electric motor.

Hall generators as described above suffer one important limitation. Their output impedance is very low—of the order of .01 to 20 ohms. Many measuring circuits will not match the peak power output of the device. Although it is not possible to obtain much power from the Hall generator in a high impedance device, the output voltage can be easily measured by high impedance voltmeters.

The above limitation applies primarily to the polycrystalline, low impedance Hall generator. On the other hand, another type can be used for some special applications. This is frequently called the "junction Hall generator." This device is made from single crystalline material usually of fairly high resistivity, and having a high output impedance.

The theory for the junction Hall generator is not as well developed as for the polycrystalline Hall generator.

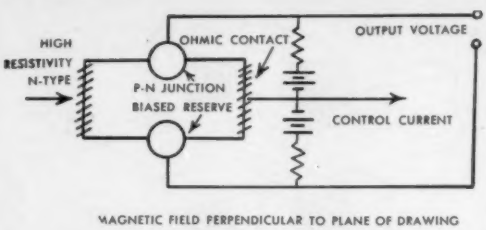


Fig. 5 A junction Hall generator, made from a single crystalline material of fairly high resistivity, having a high output impedance

However, qualitatively it can be understood by examination of fig. 5. The current carriers are deflected to one side of the generator due to the magnetic field. This in turn affects the leakage characteristics of both the junctions applied to opposite faces. In this way, the current through the load resistors changes by an appreciable factor. Due to the high value of load resistor and the high voltage applied to these devices, the output impedance of the junction Hall generator may be of the order of 500,000 ohms.

Theoretically, the junction Hall generator would seem to have as many, if not more, applications than the polycrystalline type. Unfortunately, the theory of operation underlying the junction Hall generator has not been developed very well. These devices are usually quite nonlinear as well; but for certain applications where a high output impedance is necessary, special calibration techniques could be used that would enable use of the device.

The junction Hall generators generate rather low power and, having a semiconductor junction, exhibit low frequency cut off. It may be possible to make such devices having a frequency in the low megacycle range.

Magneto-resistance

Experience has proved that electronic conductors, metals as well as semiconductors, increase their electrical resistivity when brought into a magnetic field. This effect is called the resistivity change in the magnetic field.

For the purpose of measuring the transverse resistivity change in the usual physical sense, a long conductor having electrodes at both ends, is put into a magnetic field perpendicular to the drawing plane. At first a pure electronic conductor is assumed. If a voltage is applied to the electrodes, without a magnetic field, the electrons flow in a direction parallel to the longitudinal direction of the conductor. When the magnetic field is first switched on, the electrons are deflected (by the Lorenz-force), perpendicular to the magnetic and electrical fields. Because of this, one longitudinal side of the conductor builds up a negative and the other a positive charge. This leads to an electrical field, the Hall field. This greatly simplified manner of looking at the problem does not yet result in a resistivity change in the magnetic field. In reality, however, a positive resistivity change always exists in a magnetic field. It results from the fact that electrons do not have a uniform velocity. The nonuniform velocity now makes it impossible for a single Hall field to compensate the magnetic force for every electron. Deflections of the electron trajectories occur to the right as to the left with respect to the longitudinal direction of the rod. This is the reason that electron movement in a magnetic field always leads to an increase of the electrical resistivity as compared to the case without a magnetic field.

This resistivity change is proportional to the square of the carrier mobility in the material under question. Since the intermetallic (groups III-V) semiconductors have very high electron mobilities it is now possible to make practical use of this increase in resistivity. Thus, a simple resistance device made of the proper materials and in the proper shape might show a value of resistance without a magnetic field of 0.1 ohm. When placed in a field of 10,000 gauss, however, this resistance may change by much as a factor of 25 to 50. This effect yields another method of measuring magnetic effects.

Also, the magneto-resistance change of a semiconductor with extremely high mobility can be used as a method for fulfilling some of the applications discussed for polycrystalline Hall generators. Naturally the circuitry may be just a little more complicated in this case, and magneto resistance suffers one major fault in that the resistance never falls to zero, whereas the output of the Hall generator does. In applications where zero is one of the values that is sought, the magneto-resistance devices may not be applicable. Also, such devices cannot be used for any process involving the multiplication of the control current and the magnetic field. These devices do, however, offer a simple method for measuring magnetic field strength and for indicating position, as has been outlined previously for the polycrystalline Hall generator.

The Corbino disc

The shape most often used for these experiments is shown in fig. 6. This is called a Corbino disc, after the man who first did so much work with this shape of conductor. The Corbino disc suffers another disadvantage in that the power available from such a device is limited. The resistance change is an inverse function of the radius of the inner electrode. On the other hand, the power available is a direct function of this radius. It can be seen then that for large resistance changes the power available from a Corbino disc will be limited. Conversely, if one wishes to draw a fair amount of power from a Corbino disc, the usable range of resistance change will be decreased. These devices, being made of the same materials as a polycrystalline Hall generator, also suffer from being very low impedance devices.

The development and purification of the new intermetallic semiconductors has enabled the practical use of galvano-electric effects that have been known for many years. In addition to showing promise as analog computer elements, some of these devices could revolutionize the methods now being used for measurement of some electrical quantities. END

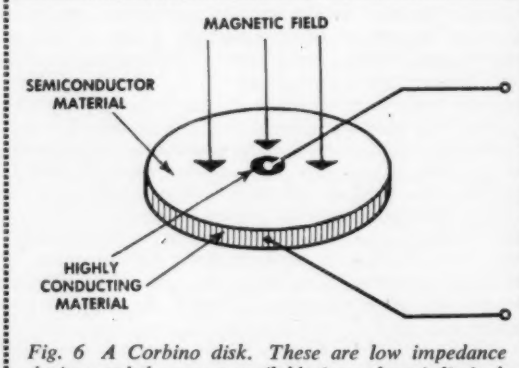


Fig. 6 A Corbino disk. These are low impedance devices and the power available from them is limited.

VERDICT on the 1957 IRE Canadian show

GOOD — big switch is to commercial products

Cross-section of opinion taken by CEE editors at the Show:

Attendance: Technical 7,647 (within 3% of last year). Slow getting going. Reasons for static figures: flue epidemic and restrictions on number of engineers attending by cost-conscious companies. Public attendance: 1,002, down by 50% on last year.

Sales potential: 60% excellent (Typical comments: We've done better than at the Wescon show; I've covered expenses on the first day), 35% average (We like to meet our friends, anyway), 5% poor (Hardly anything, we shan't be here next year).

Technical sessions: More people attending, major interest in IGY, nucleonics and medical electronics. American comment: Impressed by high percentage (90%) of very good Canadian papers.

Personal viewpoint: Room to move, high standard of displays, chance to meet everyone in the industry.

Official viewpoint: We are all very pleased at the high quality of the show. We aim to get the best in all fields—and we can honestly say we have achieved that aim (Clare Norris, chairman).

Gloom note: What is the Government going to do about defense? It should put more money into the Canadian industry. Comparison with last year: Less defense equipment, bigger trend to communications and industrial electronics. A very noticeable change.

Summing up: Show is a big boost for Canadian electronics. The industry, from its present economic plateau, looks optimistically to the future.

Next Show: Dates for third annual IRE Canadian Convention & Exposition, October 15, 16, 17, 1958.

The new world of the electronics engineer

Head table guests at the IRE Canadian banquet. Centre is Dr. Marcus Long

DR. MARCUS LONG, Professor of Philosophy at the University of Toronto, spoke at the IRE Convention Banquet on "Engineers are People." Some of his points:

THERE is great danger in these new means of communication (radio and television) for they can be controlled by single groups and distorted for personal or evil ends . . . you have provided the means for increasing understanding and enriching the lives of men; you have also provided the means for stimulating unreasonable prejudice and persuading men to cease being rational beings.

LAST year the CBC took over 40 million dollars from the public purse. The Fowler Commission has shown that a reasonably adequate program for the CBC will cost about 500 million dollars over the next six years. It is not easy to argue that such large sums of money should be spent in satisfying the tastes of minorities, in giving ballet rather than wrestling, Shakespeare rather than Zane Grey, opera rather than country hoedown. Yet this must be done.

THE electronics engineer has used his genius to free man from the pressure of work. The age of automation is upon us. . . . The engineer is well on the way to producing mechanical men who can solve the most complicated mathematical problems if fed with the proper information. Professors of Philosophy are out of luck since they seem unable to provide the machines with useful information.

IN THE new world opened to us by the electronics industry no man can say, with an easy conscience, "I am an engineer and nothing more." Under the present facts of automation, extended media of communication, guided missiles and artificial satellites no man can be only an engineer. Engineers are also people.

Dr. R. I. Primich, D R B Telecommunications Establishment received the Microwave Prize at the banquet

Members of Panel on Engineering Education, left to right: Ryder, Tracey, Laughland (moderator), Tupper, Noakes

IRE Technical Sessions

Satellite signals provide new data

Although the Soviet satellite had only been in the air for a comparatively short time when the IRE Convention and Exposition started obviously a lot of work had been done on it by the engineers present.

Lively interest was shown in the Technical Sessions where 115 papers, mostly by Canadians, were given. In the sessions on Radio Astronomy Dr. B. C. Blevis, of the Defence Research Board, Ottawa, told how the satellite had been tracked on its two frequencies of 20 and 40 mcs. From this tracking it was possible to learn more about the ionosphere for now there was a source of radiation out in space.

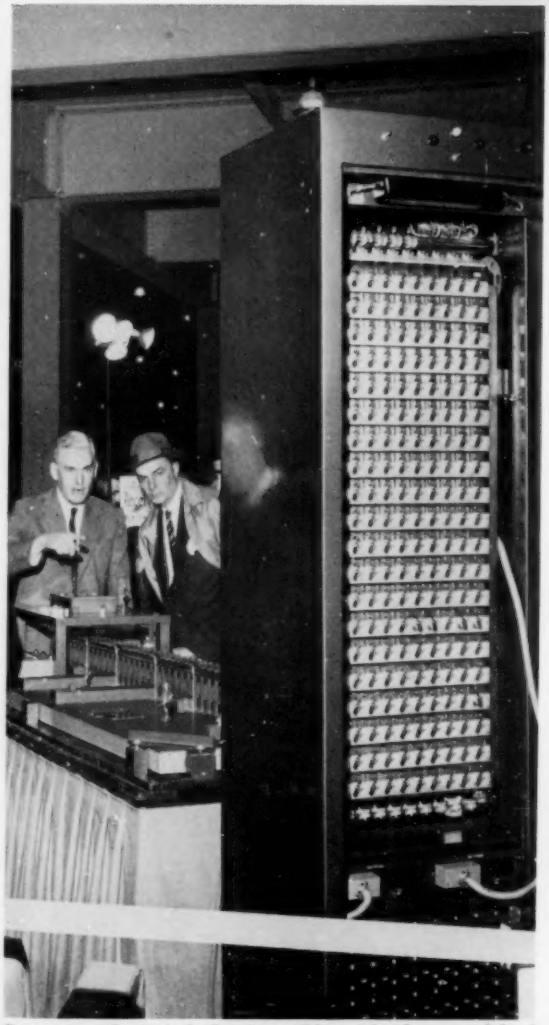
As the satellite passed over, the 40 mcs transmission could be picked up, but at low angles of incidence the 20 mcs signal was being reflected back by the ionosphere and even at high angles of incidence it was being bent.

Dr. Blevis said that although speech-modulated signals had been bounced successfully off the moon, and received back on earth quite clearly, the possible transmission of television by this method to Europe would be restricted to the time the moon was in the line-of-sight from both hemispheres—about four hours.

At the same sessions A. E. Covington delivered a paper on Solar Radio Astronomy. Recent developments have led to an increase in knowledge of the sun's atmosphere and this is important in studies related to the solar ionization of the upper atmosphere.

Northern Electric radar speed meter and closed circuit TV check Lakeshore road motorists. Many were speeding

Vanguard — almost the first man-made moon, is inspected by Dr. John T. Henderson, IRE president, R. M. Brophy of DRB, General Foulkes, chairman, Canadian Chiefs of Staff and Clare Norris, IRE Canadian Show chairman



Beaconing Optical & Precision Materials show model of the world's first semi-automatic parcel sorting system

In the field of medicine a tremendous amount of work is being done by electronics engineers. One of the latest developments in gastrointestinal pressure measurements is a small tele-metering radio pill. This was described by W. J. Bieganski of R.C.A., Camden, N.J., and J. T. Farrar, Veterans Administration Hospital, New York.

The pill, which can be swallowed quite comfortably, transmits an fm modulated signal, permitting permanent recording of gastrointestinal motility without disturbance of normal physiology.

Another paper on medical electronics covered an electronic technique for recording the sensations of a man subjected to extreme tests of acceleration and dizziness. Dr. W. H. Johnson, of the Defence Research Medical Laboratories, Toronto, said the apparatus consists of an assembly of miniature gyroscopes attached to the head, each about the size of a spool of thread.

With the apparatus Dr. Johnson said he could tell what the subject's equilibrium was, his idea of where he was and also where he thought he was going.

Redesigned keyboard

Human engineering is also of great interest to the electronics engineer — and to the communications experts. M. Humphries and J. C. Ogilvie, Defence Research Medical Laboratories, Toronto, showed a typewriter keyboard, designed some years ago, in which the operator and parameters of the input had been considered. Original placing of letters on a typewriter keyboard were determined by mechanical problems. These no longer existed, said Dr. Humphries, and the aim of keyboard designs now should be to maximize the population of potential operators, minimize training time and costs and maximize the transmission rate through the man-machine link.

In the section on Electronics for Guided Missiles David L. Duff, of Canadian Westinghouse, Hamilton, described a telemetry system for ballistic ranges. In the system a small, lightweight and extremely rugged transmitter is fitted with the ballistic model. The signal from the model is received by fixed stations and the information recorded. The model has to endure an initial acceleration varying from 5,000 to 20,000 g's and leaves the muzzle of the gun at supersonic speeds of about 3,000 ft/sec or 2,000 miles an hour.

"This one should do the job" Tom Dalzell, R-O-R shows some of company's precision components to Don C. Leith

Teacher J. W. Sturrock toured show with his students from Hamilton

IRE exhibits had the industrial look

The 1957 IRE Canadian Exposition did not produce revolutionary changes in any segment of the industry, but there were significant advances in nearly every branch. The show was predominantly commercial and experimental, with very little space devoted to military equipment.

Even Sputnik I failed to blaze more than a faint trail across the Automotive building with a tape recording of his signals at the Marconi booth and a hasty change in the Philco display to read: Vanguard—"Almost" the world's first satellite.

Components

Reliability, miniaturization and increased range of environmental conditions were responsible for many of the component changes. Rugged subminiature relays were shown by John Herring & Co., and Potter & Brumfield, Inc. Teflon (Dupont registered trade name) insulation helped them achieve the size reduction. This new insulation has created much interest since its introduction to the market and Canada Wire & Cable Co. is now producing Teflon enamel magnet wire, and hook-up wire coated with Teflon tape or glass-Teflon braid.

Size reduction means heat dissipation problems in most equipment. Rotron Manufacturing Co. displayed their new Aximax II vaneaxial fan which can deliver up to 60 cfm. The fan is only 2 in. diam. The airborne model employs an induction motor that changes shaft speed with altitude to maintain nearly constant cooling properties.

Other displays that attracted attention were the special antennas and facilities at the Sinclair booth, the Eveready solid electrolytic battery, the Alpha zipper tubing for harnessing wire, and the modular resistance-capacitance networks produced by Erie Resistor Corp. and Aircraft-Marine Products.

Dr. J. R. Whitehead, RCA and Prof. Pavlasek of McGill

Taking a close look at Erie's capacitors are J. E. Thorne, Essex Electronics, and R. Vogan of Erie

Helipot hi-temp servos shown by H. Schmidt to T. Amis, CHVC, Niagara Falls, I. Warnica, Radio College Canada

Tubes

Latest addition to the Varian line of klystrons was the VA-98, a 20 mw reflex klystron oscillator for 23,500 to 24,500 mc. It was one of the smallest klystrons on show. Eitel-McCullough placed emphasis on the high power klystrons and featured the X600 amplifier klystron capable of delivering 10 kw of CW power at 1,700 to 2,400 mc.

Honeywell Controls made a significant contribution to the field of semiconductors with their tetrode transistor. This is a germanium P-N-P, double base type transistor capable of handling 10 amps maximum at a collector voltage of 28. It features low distortion without the use of feedback.

Radar

All the radar equipment on display this year was designed for commercial applications. Decca Radar No. 45 was in operation to show the Toronto waterfront. This is the equipment that has been installed on more than 7,000 ships. Meteorological radar for storm, wind and cloud finding added to the Decca display.

To counteract low-flying motorists, Northern Electric and Canadian Admiral introduced new speed measuring radar.

At the Canadian Marconi booth

Television

The emphasis this year was on the use of television in closed circuits for monitoring hazardous operations, as well as general factory, office and school routines. Reduced price has made this possible for many applications, but, as usual, the quality is closely linked to the price.

One exception to this appeared to exist at the Pye booth. The price of their new image orthicon camera has fired a lot of interest among the show visitors.

Communications

Emphasis on SSB was evident at the Collins display. Mobile radio, amateur equipment and scatter equipment all made use of SSB modulation.

Canadian Westinghouse used a model to demonstrate their trailer housed, 5,000 mc tropospheric scatter system (featured in Aug. CEE). This has a power output of 2 kw and capacity for 120 voice channels.

(Continued on page 53)

RCAF officers Gribble & Keirstead with Honeywell's CF 105 display

Setting up a Sinclair duplexer

For your library

Simple linear systems—with paper, pencil and patience

Analytical Design of Linear Feedback Control Septems

G. C. Newton, Jr., L. A. Gould, B. F. Kaiser. John Wiley & Sons Inc., New York, 419 pp, $12.00.

Reviewed by: James M. Ham, Associate Professor of Electrical Engineering, University of Toronto.

This book is a well written and useful addition to the extensive but now relatively adequate library of texts dealing with continuous-signal linear feedback control systems in which a single output variable responds to an input signal and one or more disturbances.

The design problem for such systems consists in determining the form (often simply the values for adjustable parameters) of a compensator which when associated with the fixed part of the system (the machine, process or plant) will yield acceptable system performance. Since it is often difficult to specify practical performance objectives in our analytical forms suited to system analysis, most system design is conducted by cut-and-dry methods. Textbooks on control have reflected this situation.

This text outlines direct design procedures based on the assumption that the desired behaviour is specified and that a performance index measuring the departure from this behaviour is provided. The performance indexes used are integral squared error from desired response to specified transient inputs, and root mean square error from desired response to stochastic inputs and disturbances. While these measures of performance are by no means the only useful ones, they are almost the only ones that permit pencil and paper analysis of reasonably simple analytical form.

Much of the book is an application or extension of Wiener's statistical filter theory. The most significant sections, which are based on research of the senior author, are those showing how to introduce constraints on the values of auxiliary signals in parts of the system likely to experience saturation effects, and on the effective bandwidth of the system response.

The major contribution of the book is the emphasis on design to definite specifications, and its illustration of the inherent limits of behaviour of contrained linear systems.

Since many practical control systems are neither single input-single output systems nor linear systems, design to specifications is more and more requiring the use of simulating computers. This book shows how far one can readily go with simple linear systems using pencil, paper and patience.

Elements of magnetic tape recording

N. M. Haynes. Prentice-Hall Inc., New York; 392 pp; $7.95.

The field of magnetic tape recording has been expanding rapidly over the past few years. This book literally covers everything in magnetic tape recording and must be the comprehensive book on the subject.

The author takes in every aspect of the field, starting way back with the basic theory of magnetism and electroacoustic fundamentals. A particularly lucid part of the book deals with the principles involved in tape recording. It is accompanied by a series of first-class diagrams.

Dealing with the apparatus of tape recording the author covers flutter, tape-handling elements and mechanisms, battery-operated recorders, basic maintenance and repair. One of the main problems of tape work, he points out, is not with the recording but with the need for constancy of tape speed. No gear drive system has ever been capable of meeting the stringent requirements of flutter-free reproduction without involving the use of some auxiliary speed-stabilizing element.

Finally, the book deals with circuits, breaking them down into their various uses.

The base material that plays the vital role in magnetic recording may be only .5 mils thick. But all major advances in the art have been made in this medium. Today tapes have a tensile strength of 23,500 lbs/sq. in. and a break elongation of 70%. Photomicrographs in the book show a tape played for 10,000 times without noticeable depreciation in the signal.

Mr. Haynes, vice-president in charge of engineering, research development and design for the Amplifier Corporation of America, has produced a book that is a valuable contribution to the audio field.

Catalogues and brochures from the manufacturers

1958 Electronics buying guide. Canadian Electrical Supply Co. Ltd.

Servosystems laboratory manual. An introductory laboratory course in servomechanisms. 32 pp; $2.00. Servo Corp. of America. (724)

Relay catalogue. 36 page list of relays from leading manufacturers. Relay Sales Inc., West Chicago. (725)

Your future in electronics. Information about the Canadian Electronics Industry for the high school student who is planning his career. RETMA of Canada. (726)

Continental sub-miniature connectors. Catalogue SM757; 12 pp. DeJur-Amsco Corp., Long Island City, N.Y. (727)

How to use capacitors. The why, where and how of industrial capacitor applications. Bulletin GEA-5632B; 12 pp. Canadian General Electric Co. Ltd. (728)

Saturable reactors. Catalog R-10; 32 pp. Transfer characteristic curves, typical applications and circuits for saturable reactors for industrial and other control. Control, Butler, Penna. (729)

Potentiometer selector. 8¾" diameter selector wheel illustrates and specifies 19 potentiometers. DeJur-Amsco Corp., Long Island City, N.Y. (730)

Tape-wound cores. Bulletin TB-102 describes the three types of core material from which tape wound cores are made. G-L Electronics, Camden, N.J. (731)

X-ray fluorescent spectrometer conversion tables for topaz, lithium fluoride and other analyzing crystals. 86 pp; $2.00. Phillips Electronics, Inc., Mount Vernon, N.Y. (732)

The application of phase standards to phase measurement. Acton Lab. Report, Vol. 2, No. 2. MEL Sales Ltd., Arnprior, Ont. (733)

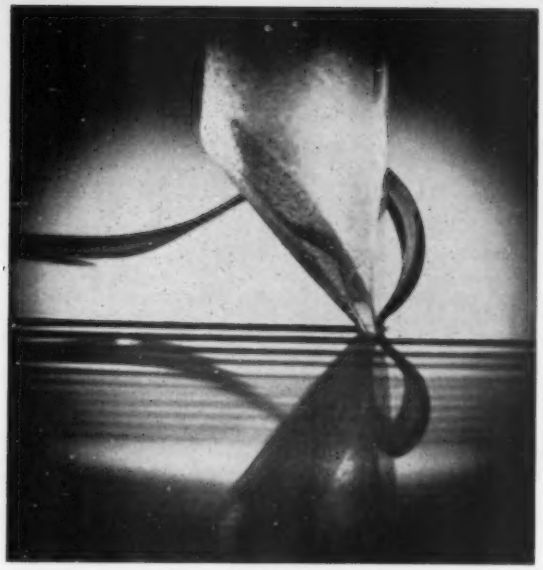
Thermocouples and extensions, color code and calibration chart. Thermo Electric (Canada) Ltd., Brampton, Ont. (734)

Work Sampling by Ralph M. Barnes. John Wiley & Sons, Inc., New York. 322 pp, $7.95. It explains means of measuring working and nonworking time of office and factory people employed on indirect activities. (735)

CEMA motor and generator standards, M1, Issue no. 1-1957. This comprehensive reference on motors and generators replaces CEMA Standards 1M to 31M inclusive. Price with NEMA standard sheets is $23.00; without NEMA sheets, $16.00. Canadian Electrical Manufacturers Assoc., Toronto. (736)

What's new in view

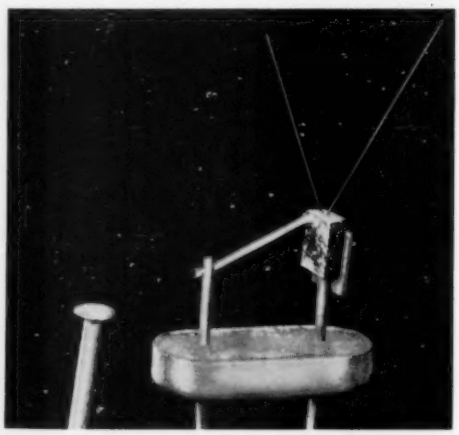
The lone electronic furrow



Photomicrograph taken at 1/1,000th second exposure, freezes the action of the cutting stylus on acetate. The cutter is ploughing an unmodulated furrow on a 78 rpm master. Picture was taken for the British Hi-Fi News by Cecil Watts whose photomicrographs of sound tracks are known all over the world

This machine, by the Crane Packing Co., Morton Grove, Illinois, can produce a flatness of under 3 light bands, a parallelism of 50 micro-inches and a thinness of .001 in. on high frequency crystals and wafers

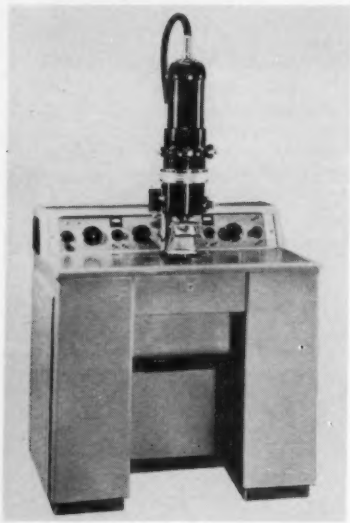
The transatlantic deep-sea telephone cable is spliced on board the cable-laying ship, HMTS Monarch. Cable connects London to New York and Montreal. Picture is by a member of Bell Telephone Laboratories.



Experimental assembly of the "spacistor" shown alongside an ordinary pin. Raytheon, who developed the device, say it will amplify at 10,000 mcs

Electron microscope designed for analytical work

The EM-75-B electron microscope has been designed for analytical work in industrial processing, research, medicine, pathology and biology. The instrument permits stereo images to be produced by rotating the specimen rod under vacuum. Magnification is continuously variable from 1200 to 12,000 diameters on the screen. Resolving power is better than 50 Angstroms. The high voltage supply is continuously variable from 20 to 75 kv and the screen image is 90 x 90 millimeters at all magnifications.



The film cassette accommodates up to 36 indexed exposures on film or 8 plates with metal viewing chamber and camera. Useful photographic enlargements may be made up to 50,000X using 35 mm film or 100,000X using glass plates. The vacuum pump is air cooled and pump-down time from a cold start is 20 minutes but only 20 seconds after changing a specimen.

Phillips Industries Ltd., Toronto. (738)

Motor-driven rotary switch

A high-speed rotary switch with rated life of 1,000 hours of continuous duty in ambient temperatures from —55C to 85C has been announced by Instrument Development Laboratories Inc. 90% "on" times per contact are available at 15 rps. The unit is hermetically sealed and the computator assembly is driven through a 13.3/1 gear reduction by a 400-cycle 115-volt single-phase motor. This switch provides time sharing of its 72 circuits BBM and other time sharing may be provided in the same basic package.

MEL Sales, Arnprior, Ont. (739)

450 ma picture tube heater

A new 450 ma, 6.3 volt television picture tube heater incorporates control of both the warm up time and current. Wound from a straight piece of tungsten, the heater is a double helical coil which makes possible the same cathode coating temperature achieved in 600 ma, 6.3 volt tubes. The construction minimizes the tendency of the heater to sag away from the cathode cap. Warm up time is approximately 11 seconds and current is regulated to ±5%.

Sylvania Electric (Canada) Ltd., Montreal. (740)

Scans 100 input channels

The Master Scanner Module, to be used with measuring instruments, permits automatic scanning of 100 input channels. Scanning time is 0.1 second per channel. The number of the channel selected is digitally displayed on a 1-in.-high edge lighted display of either three or four digits. Programming is accomplished manually but can be done with cards or tape with the addition of a programming unit.

Electromechanical Products, Agincourt, Ont. (741)

Germanium restifiers for TV replacement

A line of long-life germanium rectifiers for replacement use in TV sets is now available. They are designed to be plugged into the space formerly occupied by the other types of rectifiers. Types IN1005, IN1007 and IN1008 are halfway rectifiers capable of 250, 350 and 400 milliamperes dc output respectively. Type IN1013 consists of two germanium rectifiers connected in a voltage doubler with dc output of 250 ma.

Canadian General Electric Co. Ltd., Toronto. (742)

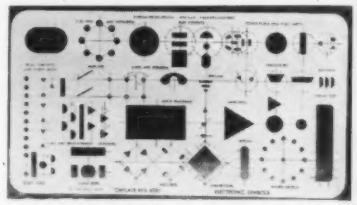
Electronic communications systems

The Dualex system of electronic communication has four basic groups that can be used alone or together for various applications. The Digital Selective Calling System is used for alerting remote locations via radio or wire circuits. It can be enlarged to include a triggering system for controlling multiple circuits in selectively called remote locations. The Unitone System, a non-synchronous sequential two-toned communication and control system, is used with the Dualex Tapewriter for sending printed messages over radio or wire circuits. The tapewriter will operate at speeds of 2 to 100 words per minute. The Pentone System is a simultaneous five-tone, non-synchronous communication and control device for wired circuits where adequate signal power can be maintained.

S. A. Armstrong Ltd., Toronto. (743)

Electronic symbol drawing aid

This drawing aid for electronic circuitry covers the newly revised Mil-Std-15A and ASA.Y32.2 specifications. Among the new symbols included are transistors, diodes, electron tubes, power plugs, pilot lamps, relays, phone jacks, amplifiers and blocks. The templates are made from dimensionally stable matte finished Vinylite.



A. Lawrence Karp, Greenwich, Conn. (744)

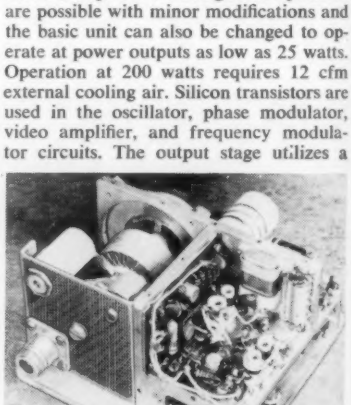
Twin power triode

High current, medium mu twin triode, type 6528, has been developed specifically for series regulator service in dc power supply units. Rugged construction has been included within the tube to make it suitable for heavy duty military and commercial use.

Alpha Aracon Radio Co. Ltd., Toronto. (745)

Transistorized 200 watt transmitter

This transistorized 200 watt PM transmitter permits long range fm/fm telemetering. The equipment is complete in one unit and transmits in the 215-235 mc range with frequency stability of ±0.01% up to 71 C. Higher frequencies are possible with minor modifications and the basic unit can also be changed to operate at power outputs as low as 25 watts. Operation at 200 watts requires 12 cfm external cooling air. Silicon transistors are used in the oscillator, phase modulator, video amplifier, and frequency modulator circuits. The output stage utilizes a



stacked ceramic tetrode with considerable excess capacity, and tubes are also used as drivers and multipliers.

Texas Instruments Inc., Ottawa. (746)

(Continued on page 47)

Carrier for telephones

Telephone service in rural areas can be increased with the Mullard rural carrier system. This provides a number of separate circuits over a single pair of wires by using frequency-spaced carrier signals. The TRC-7 system provides up to seven channels with facilities for dropping-off individual channels to subscribers at any required point. The system is fully transistorized to operate from 24 or 48 volt batteries with low power consumption.

Philips Industries Ltd., Toronto. (747)

Five digit elapsed time indicator

Series HD-656 elapsed time indicators have five digit counters that register 1/10 minute or 1/10 hour increments to 9999.9, or one hour steps to 99999. They are equipped with self starting synchronous motors for 110-125 volts 60 cps and capable of operating continuously from —55 C to +85 C. The sealed housings are a combination of drawn steel case and die cast aluminum mounting flange. The solder lugs are sealed in.

DeJur-Amsco Corp., Long Island City, N.Y. (748)

Disc-type vhf TV tuner

A new disc-type vhf television tuner is now in production at Canadian Admiral Corp. The cascode tuner has all circuits and components easily accessible to reduce servicing problems to a minimum. Instead of tuning strips, the antenna and oscillator circuits are located on two discs or rotors connected by a shaft. The tuners are built for channels 2 through 13.

Due to the sharply increased demand for sets equipped for UHF, the company is also starting production of 82-channel UHF-VHF tuners.

Canadian Admiral Corp. Ltd., Port Credit, Ont. (749)

(Continued on page 48)

Tantalum foil capacitors

A line of tantalum foil electrolytic capacitors is being produced in limited quantity for engineering evaluation and use. The Tan-O-Mite series TF capacitors have a long shelf and operating life, stability and high capacity per unit volume. The operating temperature is —55 C to +85 C and the capitance range is .25 to 140 uf. Polar units are designed for d-c applications where reversals do not occur and nonpolar units for applications where potential reverses do occur, or for a-c of limited voltage.

Ohmite Mfg. Co., Skokie, Ill. (750)

Protects cable near door hinge

Flexible cable trunking has been developed to sheath groups of wires connected between cubicles and doors. Insuloid Flexiguard consists of two identical nylon brackets connected by a flexible P.V.C. tube for sheathing the cables in their route from cubicle-to-door. Brackets are available in four sizes and the tube can be cut to any desired length.

Electrovert Ltd., Montreal (751)

Tool installs wire terminals

This combination hand tool, model WT-152, performs both as a wire cutter and as installation pliers for self-insulated Sta-Kon wire terminals. It will install RA, RB and RC series terminals designed for wire sizes 22 through 10 AWG. The skinned wire is inserted into the terminal and staked with the WT-152. The resultant connection electrically terminates the wire and mechanically grips the insulation. The wire cutter is in the side of the tool.

Thomas & Betts Ltd., Montreal (752)

Transistorized power supplies

Small ac to dc power supplies for filament, transistor and plate voltage applications use transistors to maintain regulation within 5%, or within 0.01% on custom units. Outputs to 28 vdc at 15 amps, or 2500 vdc at 300 ma are available in standard units from 115 vac, 60 cps, single phase; from 115 vac, 400 cps, single or three phase inputs.

Also available are a series of ac to dc converters for portable, aircraft, and vehicular electronic equipment. Standard units are available for 12 and 28 volt inputs, in a number of nominal output voltages from 120 to 2100 volts, and in power outputs up to 500 watts. The transistorized units can give regulation within 0.25%.

Electronic Enterprises, Regd., Toronto. (753)

(Continued on page 51)

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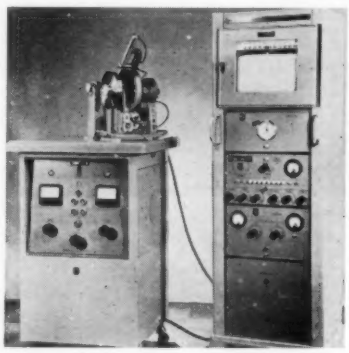
X-ray diffractometer analyses powdered materials

The sensitivity, accuracy and application range of the Norelco X-ray diffractometer have recently been extended. Developed for X-ray powder diffraction work, the unit can accommodate high and low temperature chambers, devices for preferred orientation and pole figure studies, focussing monochromators and similar accessories.

Three components are used: 1. Basic X-ray generator and tube. 2. Wide-range goniometer with detector. 3. Electronic circuit panel with strip-chart recorder. The goniometer accommodates scintillation, proportional, flow or geiger counter units to provide a wide choice of detectors for all conditions. X-ray tube is enclosed in a ray-proofed housing in the centre of the table top on the basic generator. Each of the four sides of the housing has a window through which X-rays will pass and this allows the use of four cameras simultaneously. Two goniometers and two cameras may be attached to the ports at one time.



X-ray tube and transformer are water cooled and the system has safety devices, interlocks, exposure timer, operating time totalizer and power outlets. The diffractometer is designed to operate on 200-240 volts ac, 50 or 60 cps. X-ray tube current is provided with stepless controls to give up to 60 kvp and 50 ma.

Philips Industries Ltd., Toronto. (754)

Special purpose crt's

Substantial savings in chassis weight are offered through a new series of six special purpose crt's. Designated as the 12ABP series, the new tubes, designed for use in radar indicators, use electrostatic focus and magnetic deflection. The tubes are available in a variety of fluorescent or phosphorescent colors, and with either long or medium-long persistency.

Sylvania Electric (Canada) Ltd., Montreal. (755)

Soldering iron for small work

Designed primarily to do fine precision soldering on miniature and subminiature components and assemblies, these soldering irons can also be used on larger equipment. They are available from 17 to 30 watts capacity, 12 volts output and come complete with transformer rated at 110-120 or 220-240 volts ac input. Tips are Armco ingot iron, tinned for long life and in either diamond or chisel shapes.

American Electrical Heater Co., Detroit. (756)

Deflection yoke cores for 110° tubes

Designed for the new 110 degree TV picture tubes, the Stackpole "Ceramag" cores are molded as single units then halved for assembly into the deflection coil. The method of cutting and rejoining the halves minimizes air gaps and flux leakage. The cores are flared to reduce material requirements.

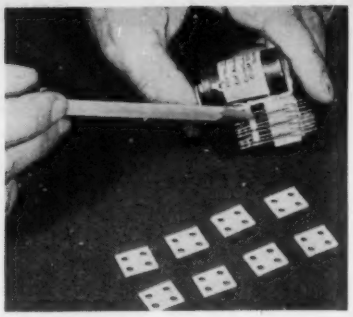
Stackpole Carbon Co., St. Mary's, Pa. (757)

(Continued on page 52)

Silicone resin laminate has high heat resistance

A glass-base, silicone resin laminate, Phenolite G-7-830, developed for high temperature electrical applications has a heat resistance rating of 500-F short time, and 400 F continuous time. Dielectric strength perpendicular to laminations is 400 volts per mil, short time, for 1/16 in. thicknesses and 350 volts per mil, short time, for ⅛ in. thickness. The material is currently being used in such applications as relay spacer blocks where it is required to have high temperature and dielectric properties, low volatile content and good punching qualities.

National Vulcanized Fibre Co., Wilmington, Del. (758)



Induction heater gives 25 kw

The Philips 25-kw induction heater features a continuous work coil matching device which provides optimum power transfer to the work piece by a simple turn of the wheel. At the same time it controls the power output to the desired level. The generator is housed in two cabinets equipped with a remote control on-off foot or hand switch which can be worked in conjunction with a number of available process timers.

Philips Industries Ltd., Toronto. (759)

Electronic time delay relay

Standard models of these electronic time delay relays are available with time delay periods from .01 to 60 seconds between application of current and pull-in of relay contacts. Timing accuracy is ±10% of nominal through a temperature range of —55C to + 125C. Through the use of transistors and rc time constant circuits, all moving parts except relay contacts have been avoided. Units are vibration-proof up to 20gs and 2000 cps, and will withstand shock of 40 gs for 11 milliseconds. Standard input requirements are 18 to 31 volts dc.

Tempo Instrument Inc., Hicksville, N.Y. (760)

Breadboard components test servos

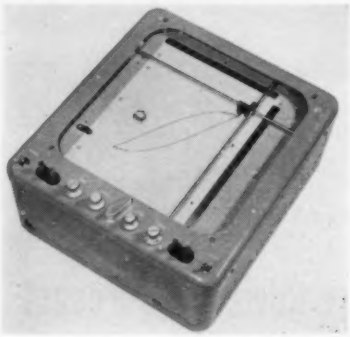
Servo designers can speed appraisal of their servo components and systems with the Vactric breadboard components. These enable the designer to build his prototype quickly, then dismantle it for use again.

Vactric (Control Equipment) Ltd., Montreal. (761)

(Continued on page 53)

X-Y plotter works on input of 1 millivolt per inch

Model ER-90 x-y plotter features a flat bed construction for full chart visibility and a slip-on pen plotting on standard 8½″ x 11″ paper. It has an input sensitivity of one millivolt per inch and uses conventional chopper stabilized amplifiers, standard 3 turn rebalance potentiometers in the null seeking servo system plus a simplified cord drive system.



The two axes are electrically independent and the manufacturer claims that the recorder has a limit of errors better than 0.75%, and a repeatability better than 0.05%.

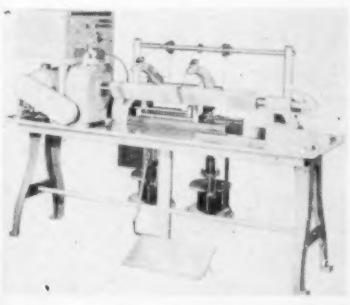
Mandrel Industrial Instruments, Houston, Texas. (762)

Transistorized ac-dc converter

The Electro Instruments transistorized converter changes average ac signals to dc. When used in conjunction with other equipment, input data can be automatically digitized. Measurements are presented on one-inch-high edge-lighted numerals contained in the face panel. Ranging of the unit is automatic from 30 to 10,000 cps and the dynamic range is 0.1 mv to 1,000 volts.

Electromechanical Products, Agincourt, Ont. (763)

Tronsformer & bobbin winder



Model 149-AM winds power, audio and similar types of heavy duty transformer coils as well as all types of heavy duty field coils and bobbins in wire sizes from 4 to 23. Maximum coil o.d. is 16 in., maximum coil length 10 in, maximum loading distance for multiple winding 30 in., winding range from 4 to 40 turns per inch and winding speeds 30 to 140 rpm. Furnished with the machine are heavy duty positive locking tailstock, magnetic brake, automatic counter, a complete set of gears and 1 hp motor.

Geo. Stevens Mfg. Co. Inc., Chicago. (764)

System measures level of liquid

The Data-Gage transistorized system measures the level of liquid in any of 100 remotely located storage tanks. The major components of the system are a receiver console, field selector unit, and liquid level gauge using a float of new design. The entire system may be installed at the tank site, or the receiver console may be located in a remote office. Direct wire, telephone, carrier or microwave transmission may be employed. Up to 100 tanks or stations may be monitored on a single system, with a liquid depth up to 64 feet in each tank measured with an accuracy of 1/16 in. No electrical wires enter the tank.

Texas Instrument Inc., Ottawa. (765)

(Continued on page 56)

Instruments use transistors

Improved signal intelligibility is the object of equipment that was displayed by Canadian General Electric and Hoover Electronics. The CGE synchronous detector embodies a double sideband, phase locking feature to reduce received signal distortion and interference. It also is compatible with most present forms of communications. The Hoover interference blanker senses the wavefront of static and disconnects the antenna from the receiver for a 10 microsecond interval. This improves reception, particularly in aircraft.

Computers

A TCA hostess, operating Ferranti's business transactor, attracted crowds at the show. The transactor provides digital computers with input and output facilities that are essentially in plain language form.

The operator pencil marks cards and the machine reads these and transmits the information in serial form in 12-bit words. The computer output is returned to the card in the form of notches along the edge.

The system can be used for airline reservation control and can supply a reply in only a few seconds.

Instruments

Automatic controls and computers have spurred the design of indicating instruments and recorders. Many of these are now transistorized. Typical are the Century Model 420 electrograph using light beam type galvanometers and the Sanborn 6- and 8-channel recording consoles.

A new addition to the oscilloscope field is the Bach-Simpson Model 2610. Vertical response is dc to 6 mc; linear time base is 3 cps to 500 kc with connections available for external time base. Vertical sensitivity is 3.3 mv (rms) per cm.

To study the audio spectrum, Kay Electric developed the sona-graph. It provides three recorded analyses of the sound waves. The first relates frequency and intensity to time; the second relates intensity to frequency at any selected time; the third relates the average available amplitude to time.

The study of high-speed phenomena is possible with the Ampex FR-100 recorder. This is done by recording the action on magnetic tape at a high rate, then playing back the information at reduced speed to gain time-base expansion. Slowdowns of over 1,000 are possible.

Miscellaneous

A few new audio tape recorders were present at the exhibition, most of them being British. The Winston Thoroughbred at the Mechron booth and the Ferrograph at the Astral booth have both been adapted to the North American standard power input of 110 v, 60 cps. Tape speeds are 15, 7½, and 3¾ ips.

Cossor (Canada) Ltd. have introduced another speaker for use with transistor circuits. The new 8-in. model has a centre-tapped voice coil of 1,000 ohms impedance for direct coupling to the output stages of a transistorized amplifier.

There were many other interesting items on display, but space has limited this report to a description of only a few of the more significant developments. END

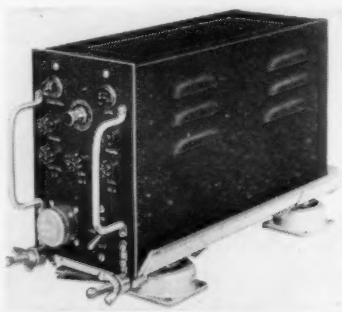
New products — cont.

Sine-to-square wave converter range is 5—100,000 cps

This sine-to-square wave converter utilizes the signal from the driving oscillator to provide operating power for the transistor squaring circuit. Operating from five to 100,000 cps the unit is capable of 17 volts peak to peak output upon being driven from almost any conventional oscillator. Rise time for the square wave produced is 0.5% of the period with a symmetry of 50% ± 2%.

Mandrel Industrial Instruments, Houston, Texas. (766)

400 cycle voltage regulator

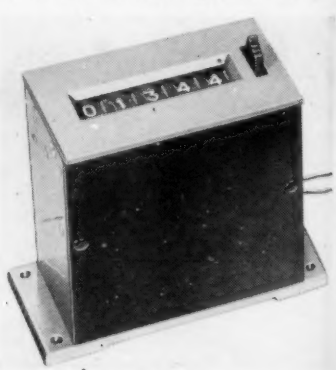


Type IEH5101 Stabiline automatic voltage regulator is designed to hold the line voltage within 0.25 volt bandwidth for line voltage variations and 0.35 volt bandwidth for load current and load power factor changes. It operates at 400 cycles, single phase, 95-130 volts input, 110-120 volts output (adjustable), 1.0 kva.

The American Superior Electric Co. Ltd., Toronto. (767)

Counter has electric reset

Model YE can operate up to 1,500 counts per minute and can be instantly reset to zero either electrically or mechanically. They are available in four models for panel or base mounting, electrical or mechanical reset. Operating voltages are 115 v, 60 cps, 115 vdc or 28 vdc. Coil resistance is 1360-1400 ohms; line power is 8.5 watts for counting and 15-19 watts for resetting at 115 vac.



Durant Mfg. Co., Milwaukee. (768)

Advertisers' Index

POST OFFICE PLANS BIGGER AND FASTER MAIL SORTER

Canada's post office, having developed the first electronic mail sorter, is now ordering faster and bigger machines. When the Universal Postal Union Congress met in Ottawa delegates looked over the mail sorter which can handle 36,000 pieces an hour.

Deputy Postmaster General Walter Turnbull told delegates that the machine is designed for medium-sized cities of 250,000 people. This machine, three years in development, has cost around $2 million to date.

Round-up: news and future events

For larger installations the post office is planning machines working at 54,000 and 72,000 pieces an hour. These machines will need another two years for development, will then go to Toronto and Montreal.

Dr. Morris Levy, technical advisor to the post office, said the computer drum had a capacity of about half a million bits in which could be stored the 10,000 to 12,000 names of Canadian cities and towns, and all the streets and division of streets in Ottawa.

The conveyor systems, coding desks and gate selector of the machine were developed by a team of designers on loan from Beaconing Optical and Precision Co., Montreal. The high-speed printer was developed by Pitney Bowes and the sorter was built by Ferranti Electric and Canadian Arsenals Ltd.

Engineers want reliability

One of the immediate problems in the electronics field is the development of more reliable semi-conductors, particularly for use with magnetic amplifiers. At least, that was the complaint of engineers, 400 of whom attended a special conference on magnetic amplifiers sponsored by the AIEE and IRE in Pittsburgh.

Twenty technical papers were presented on topics such as instrument applications, new techniques in the design of polyphase magnetic amplifiers and a unified approach to magnetic amplifier design.

Sessions on theory and applications discussed new theoretical treatment in connection with triggering and magnetic material behavior.

Backroom boys

Men behind the electronic sorter in the Ottawa post office: left to right, Deputy Postmaster General Walter Turnbull, C. G. Helwig (Ferranti Electric Ltd), Dr. Morris Levy (technical adviser, P.O.), G. K. Freel (Canadian Arsenals Ltd).

COMING EVENTS

November

4-6 Machine Tool Conference, Milwaukee.

6-7 Third Annual Symposium on Aeronautical Communications. Utica, N.Y.

6-8 Electrical Techniques in Medicine & Biology Conference. Harvard University

11-13 Radio fall meeting, EIA, RETMA & IRE Professional Groups, King Edward Hotel, Toronto.

13-14 IRE Mid-America Electronics Conference. Kansas City.

December

9-13 Eastern Joint Computer Conference. Washington, D.C.

January 1958

27-28 AIEE - IRE Scintillation Counters Conference. Washington, D.C.

February

2-7 AIEE Winter General Meeting. New York.

20-21 AIEE-IRE-U of P Transistor & Solid State Circuits Conference. Philadelphia.

March

17-21 EJC Nuclear Congress. Chicago.

24-27 Radio Engineering Show & IRE National Convention. New York.

Tacan—major aid in navigation

TACAN, acronym for Tactical Air Navigation, provides the pilot with continuous, precise distance and bearing information for navigation at ranges up to approximately 200 miles. The system includes an airborne interrogating transmitter and receiver and a ground beacon consisting of receiver-transmitter and special rotating antenna.

The Tacan system will be the subject of the main article in December's Canadian Electronics Engineering. In the same issue will be articles on present day recording techniques, the development of Telfon as an insulator for various types of wire (of great interest to design engineers running into heat problems) and a new way to solder aluminum.

New CEMA chief

Thomas J. Bell, president of Fiberglas Canada Ltd., has been chosen to lead Canada's $1.2-billion electrical industry. He was elected president of the Canadian Electrical Manufacturers Association at their 13th annual meeting.

Computer will simulate airport traffic

One of the largest computers in the world, designed and built by Computing Devices of Canada Ltd., in Ottawa, is going to be used by the U.S. Civil Aeronautics Administration in the study of day-to-day air traffic control problems.

Increasingly heavy traffic at major airports involving high speed jet aircraft have posed serious problems in air traffic control. The use of the simulator will make it possible to test new traffic patterns, communication and navigation systems without the cost and risk of using actual aircraft. Approximately 100 aircraft will be simulated simultaneously.

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